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September 30, 1975

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NOTICE

A title page for Volume 32, Numbers 1–6, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 30, No. 10, Abst. 28530, line 3 should read: 2200 m/s. Deruytter, A. J.; Becker, W. (Commission of the

NSA Vol. 30, No. 10, Personal Author Index, page 50, Seruytter, A. J. should read: Deruytter, A. J.

Volume 32, Number 6, September 30, 1975

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

HOLLOWAY, J.A., Survey of image processing methods for radiography, 31:16451
HOLLWEG, J.V., Hydromagnetic waves in interplanetary space, 31:17953
HOLMBERG, E.B., Distribution of clusters of galaxies as related to galactic absorption, 31:18040
HOLMES, J.J., See BATES, J.F., 31:17444

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

NUCLEAR POWER PLANTS/REACTOR LICENSING
Experience acquired in the design and construction of operating plants (German Federal Republic), 31:19104
NUCLEAR POWER PLANTS/REACTOR SAFETY
Conception of radiation safety in atomic electric power plants, 31:15032 (CONF-701074-P1)
NUCLEAR POWER PLANTS/SITE SELECTION
Safety-related site parameters for nuclear power plants, 31:19052 (WASH-1361)
Status and development of nuclear power in the Federal Republic of Germany, 31:19105
NUCLEAR PROPERTIES/RESEARCH PROGRAMS
Accelerator physics group progress report, July--December 1973 (Research summaries), 31:18544 (INS-R-139)

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17606 (ANL/HEP-7440, pp I.1-I.12) ACCELERATED POLARIZED PROTONS AT THE ZGS. Ratner, L. G. (Argonne National Lab., IL). Feb 1974.
From symposium on high energy physics with polarized beams; Argonne, Illinois, USA (8 Feb 1974).
In symposium on high-energy physics with polarized beams.

is indexed as:

ARGONNE NATIONAL LAB., ILL. (USA)
Accelerated polarized protons at the ZGS, 31:17606 (ANL/HEP-7440)
Acceleration of polarized protons in synchrotrons, 31:17692 (ANL/HEP-7440)
Analysis of population, birth, and death statistics in the counties surrounding the Big Rock Point Nuclear Power Station, Charlevoix County, Michigan, 31:16552 (ANL-8149)
Argonne polarized target facilities, 31:17762 (ANL/HEP-7440)
Calculation of transient fission-gas release from oxide fuels, 31:19031 (ANL-8143)

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WASH-		
1164	31:19025	Dep. NTIS, $10.60
1359	31:16524	Dep. NTIS, $10.60
1361	31:19052	Dep. NTIS, $3.75
WCAP-	(Misc.)	
7966	31:19053	Dep. NTIS, $5.50
XDC-		
69-3-68	31:18403	Dep. NTIS, $7.25
XN-	(Non-ERDA)	
74-21(Rev.1)	31:19034	
209(Suppl.4) (Rev.1)	31:18750	Exxon, Richland, WA
Y-		
1966	31:19188	Dep. NTIS, $4.00

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Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 32, Number 6 September 30, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

13714 TABLITSY I S KHEMY ANALITICHESKOI KHIMII. (Tables and Diagrams for Analytical Chemistry). Musakin, A. P. Leningrad; Izdatel'stvo Khimiya Leningradskoe Otdelenie (1975). 136p.

Tables and diagrams are presented, which may be used for ready orientation in various analytical properties of substances and may be used in selecting analytical methods for various simple and complex materials. The general nature of the analytical properties of ions in solution is considered along with a description of the action of reagents on different ions and compounds and methods for determination and separation of ions. The book is designed for scientific workers and laboratory assistants and for industrial laboratories. It may also be used for students in colleges and technical schools. (tr-auth)

Activation and Nuclear Reaction Procedures

13715 (CEA-CONF-2980) APPLICATION OF THE $^{1}H(^{11}B, \alpha)\alpha\alpha$ REACTION TO THE ANALYSIS OF HYDROGEN IMPLANTED IN SILICON. Guivarc'h, A.; Piaguet, J.; Danielou, R.; Fontenille, J.; Ligeon, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1974. 9 p. (In French). INIS.

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974).

The $^{1}H(^{11}B, \alpha)\alpha\alpha$ nuclear reaction at low energy (2MeV) was used for measuring the concentration profiles of hydrogen implanted in Si at energies between 1.5 and 50 keV ($3.10^{16}H/cm^{2}$). This method was also applied to the determination of hydrogen absorbed on Si surfaces. (FR)

13716 (CEA-N-1746, pp 19-24) HYDROGEN ANALYSIS AND LOCALIZATION. Ligeon, E. 1974. (In French).

In First semi-annual progress report 1974. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

Hydrogen diffusion in solids is usually investigated by measuring the whole hydrogen amount contained in the samples. Improvement to measurements was obtained by using nuclear reactions induced by low energy heavy ions, and measuring the hydrogen amount contained in layers less than 500 A thick. The depth resolution is about 400 A. Furthermore, these heavy ion beams allow channeling and localization methods (nuclear reaction $H(^{11}B, \alpha)\alpha\alpha$) for studying hydrogen-doped single crystals. (FR)

13717 (CNAEM-R-131) DETERMINATION OF HEAVY METALS IN TREES BY NEUTRON ACTIVATION ANALYSIS. Gulbaba, G. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The relative levels of trace elements amenable to instrumental activation analysis were determined in samples taken through a cross-section of a tree, in search for evidence of changing levels which might be related to pollution. Ag, As, Br, Cd, Cr, Fe, Hf, Mn, La, Ta, V, Yb, and Zn were identified. (LK)

13718 (IRI-133-73-16) VANADIUM CONCENTRATIONS IN GRASSLANDS AROUND ARNHEM (NETHERLANDS). de Goeij, J. J. M.; Bode, P.; Zegers, C. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1973. 16p. (In Dutch).

Concentrations of vanadium, aluminium, chlorine, magnesium, manganese, and titanium in grasses near Arnhem (Netherlands) were determined by neutron activation analysis. Gamma spectroscopy with a lithium drifted germanium detector was applied for the analysis of the irradiated samples. (NL)

13719 (NP-20343, pp 137-140) NEUTRON ACTIVATION ANALYSIS OF SHORT-LIVED NUCLIDES WITH IMPULSE AND STEADY IRRADIATION. Determination of Lead by 0.8 sec Lead-207m. Menke, H.; Weber, M. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13720 (NP-20343, pp 140-143) IRRADIATION OF JEWELS IN THE REACTOR. Seyb, K. E. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13721 (SUNI-37) ANNUAL RESEARCH REPORT, 1974. McMurray, W. R. (comp.). (Southern Universities Nuclear Inst., Faure (South Africa)). 1974. 73p. Dep. NTIS (US Sales Only) $6.75.

Progress is reported on research in the areas of nuclear reactions and structure, nuclear analytical chemistry, atomic physics, applications of nuclear techniques, and feasibility study for a national accelerator facility. Separate indexing was done for each of 16 sections. (MCG)

For abstracts of individual sections see: 13722–13726, 13828, 15467–15469, 15543, 15819, 15842–15844, 15883, and 15953.

13722 (SUNI-37, pp 17) NEUTRON ACTIVATION ANALYSIS OF ARCHAEOLOGICAL MATERIAL. Boulle, G. J.; Peisach, M. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

13723 (SUNI-37, pp 20-21) MAGNESIUM DISTRIBUTIONS IN ALUMINUM USING A DEUTERON MICROBEAM. Olivier, C.; Peisach, M. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

13724 (SUNI-37, pp 21) DETERMINATION OF BORON IN STEELS BY MEASUREMENT OF THE ALPHA-PARTICLES EMITTED DURING CHARGED PARTICLE IRRADIATION. Olivier, C.; Pierce, T. B. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

13725 (SUNI-37, pp 22-23) DETERMINATION OF NITROGEN IN THE PPM RANGE IN STEELS BY THE MEASUREMENT OF PROMPT CHARGED PARTICLES EMITTED DURING DEUTERON IRRADIATION. Olivier, C.; Peisach, M.; Pierce, T. B. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

13726 (SUNI-37, pp 26) CEMENT ANALYSIS BY CHARGED-PARTICLE INDUCED X-RAYS. Peisach, M.; Meyer, B. R.; van Heerden, I. J. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

13727 NEUTRON ACTIVATION ANALYSIS TABLES. Leclerc, J. C.; Cornu, A. London; Heyden (1974). 64p.

The subject is covered in three parts: part one is devoted to general information about the elements, atomic number and symbols, atomic weights, natural isotopes and their abundances, relationship of natural isotope to radionuclide and conversely of

radionuclide to natural isotope, and capture cross-sections of isotopes; part two contains a list of gamma energies for radionuclides classified alphabetically and in numerical order; part three includes some work by the present authors which attempts to resolve two important problems in activation analysis: first, the calculation of the optimum weight of standard which is required to give a suitable level of activity; and second, the calculation of the saturation sensitivity for any given gamma energy peak. (auth)

13728 DETERMINATION OF MERCURY IN TOTAL DIET SAMPLES BY NEUTRON ACTIVATION. Tanner, J. T. (Food and Drug Administration, Washington, DC); Forbes, W. S. Anal. Chim. Acta; 74: No. 1, 17-21(Jan 1975).

The mercury contents of food samples representative of the total diet have been determined by neutron activation analysis. The mercury was separated by anion-exchange chromatography and precipitated as the sulfide. The mercury concentrations for the different fractions of total diet samples were well below 50 ppb. Only in the meat, fish and poultry fraction were measurable amounts of mercury encountered regularly. (INIS)

13729 DETERMINATION OF OXYGEN IN COPPER BY α-PARTICLE ACTIVATION ANALYSIS. Vandecasteele, C.; Adams, F.; Hoste, J. (Ghent Rijksuniversiteit). Anal. Chem.; 76: No. 1, 27-36(May 1975).

The determination of oxygen in copper by activation analysis with 45-MeV α-particles is described. The chemical separation of ^{18}F produced from oxygen consists of steam distillation as fluosilicic acid, followed by precipitation of the interfering gallium activities as the hydroxide and of the fluoride as lead chlorofluoride or of cation exchange followed by lead chlorofluoride precipitation. This allows a total decontamination from matrix radiation in excess of 10^6. Mica foils are used as a standard, while for the purpose of flux monitoring, the activity induced in a thin copper or mica foil placed before the sample is counted. Alternatively, the intensity of the particle beam is measured. The method, which allows determination of oxygen at the 1 μg/g level with a precision of about 10% is applied to the determination of a concentration of 1.2 μg/g. Analysis of a reference material containing 70 μg 0 per g proves the accuracy of the standardization methods applied. (NL)

13730 SUBSTOICHIOMETRIC EXTRACTION OF CHLORIDE COMPLEX OF ANTIMONY(V) WITH TETRAPHENYLARSONIUM IN NEUTRON-ACTIVATION ANALYSIS. Perezhogin, G. A.; Gavrilova, L. P. Zh. Anal. Khim.; 30: No. 4, 725-728(Apr 1975). (In Russian).

The extraction of the chloride complex of antimony (V) into dichloroethane or chloroform as its salt with tetraphenylarsonium was used for substoichiometric separation. The effect of competitive and interfering elements was examined. The neutron-activation method involving the substoichiometric separation was used to determine antimony contents in international standards W-1 and MAG-1. (auth)

13731 DETERMINATION OF OXYGEN IN MOLYBDENUM AND IN ALLOYS BASED ON TUNGSTEN. Dubinskii, S. A.; Nikolaenko, O. K.; Shtan, A. S. Nauch. Tr., Vses. Nauch.-Issled. Proekt. Inst. Tugoplavkikh Met. Tverd. Splavov; No. 13, 133-137(1973). (In Russian).

The determination of 40 to 400 ppM of O in such samples is based on the nuclear reaction $^{16}O(n,p)^{16}N$. The sample and a Plexiglas standard (32% of O) in the form of a disc of 39 mm diameter and 9 mm thickness are irradiated for 30 sec. with $\simeq$ 14-MeV neutrons produced in a neutron generator (output $\simeq 10^9$ neutrons per sec.), and, 1 sec. after the end of the irradiation, the γ-radiation from ^{16}N at 1.72 to 8.87 MeV is counted with use of three NaI(Tl) crystals. Corrections applied for self-shielding and self-absorption effects and for the presence of B and F are discussed. (Ref. Zh.)

13732 DISCOVERY AND ANALYSIS OF MICROELEMENTS IN SOME PLANTS BY NEUTRON ACTIVATION. Kenia, O. T.; Danelia, G. I.; Osei, Yu. P.; Mosulishvili, L. M.; Macharashvili, G. R.; Shonia, N. I. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 78: No. 2, 453-456(May 1975). (In Russian).

The contents of Hg, Cr, Cs, Rb, Zn, Fe, and Co in soy and maize was determined by the instrumental method of neutron activation. The sensitivity of determination of the indicated elements was calculated. The experiment was carried out in a reactor, employing the Ge(Li) detector; the flow of neutrons was 1.10^{13} neutron/cm^2. sec.; exposure time 5 days. (auth)

13733 CONTAMINATION OF SOILS NEAR A COPPER SMELTER BY ARSENIC, ANTIMONY, AND LEAD. Crecelius, E. A. (Univ. of Washington, Seattle); Johnson, C. J.; Hofer, G. C. Water, Air Soil Pollut.; 3: No. 3, 337-342(Sep 1974).

Stack dust from a large Cu smelter near Tacoma, Washington has contaminated soil with As, Sb, and Pb. Within 5 km of the smelter 380 ppM (dry weight) As, 200 ppM Sb, and 540 ppM Pb have been measured in the surface soil (0 to 3 cm). Plants grown in these soils may be affected and also the consumption of plants coated with this heavy metal rich dust may be of concern. (NL)

13734 DETERMINATION OF HEAVY METALS IN MUNICIPAL SEWAGE PLANT SLUDGES BY NEUTRON ACTIVATION ANALYSIS. Weaver, J. N.; Hanson, A.; MacGaughey, J.; Steinkruger, F. J. (North Carolina State Univ., Raleigh). Water, Air Soil Pollut.; 3: No. 3, 327-335(Sep 1974).

Neutron activation analysis was applied for the determination of heavy metals concentrations in sludges from six North Carolina cities. Metal content variations and possible meanings for these variations are presented along with the precision and potential of neutron activation analysis for trace metal scanning. (NL)

13735 RARE-EARTH ELEMENT DISTRIBUTION IN BASIC AND ULTRABASIC ROCKS FROM WEST NORWAY. Garmann, L. B.; Brunfelt, A. O.; Finstadt, K. G.; Heier, K. S. (Mineralogisk-Geologisk Museum, Oslo). Chem. Geol.; 15: No. 2, 103-116(Apr 1975).

Samples of ten eclogites in gneiss, one eclogite in dunite-peridotite, three dunites, and four garnet- and dunite-peridotites from the Nordfjord–Molde area in west Norway were analyzed for La, Ce, Nd, Sm, Eu, Gd, Tb, Yb, and Lu by radiochemical neutron activation analysis. The chondrite normalized rare-earth elements (REE) patterns of eclogites in gneisses show mostly slight enrichment of the heavy REE, which converge towards a value about ten times above the average chondrite. It is suggested that the light REE scatter is due to the original mineralogical composition of the rocks. One garnet-peridotite shows a distribution pattern similar to those reported for high-temperature peridotites while the two others could be compared with that of Lac de Lherz and Stillwater peridotite. Two of the dunites taken from the same locality show a difference in the individual REE content by a factor of one order of magnitude. This is explained by the higher content of tremolite in the most REE-enriched sample. (NL)

13736 MERCURY IN THE SOUTH POLAR SEAS AND IN THE NORTHEAST PACIFIC OCEAN. Williams, P. M. (Univ. of California, LaJolla, San Diego); Robertson, K. J.; Weiss, H. V.; Chew, K. (Univ. of California, LaJolla, San Diego). Mar. Chem.; 2: No. 4, 287-299(Dec 1974).

Seventy-nine total-mercury analyses of seawater samples, collected from the surface down to 5,700 m depth in the northeastern Pacific Ocean and in the South Polar seas, showed a homogeneous distribution of mercury with depth at all stations, although its absolute concentration in the northeastern Pacific (12 to 30 ng/kg) was 3 to 5 times less than that in the polar waters (50 to 150 ng/kg). The high concentrations are ascribed to an input of mercury resulting from submarine volcanism. The mercury content was also determined in eight surface-film samples, three sediment cores (0 to 30 cm), pack-ice samples, and one sample each of snow and sea smoke. (NL)

13737 LOSS OF OSMIUM DURING FUSION OF GEOLOGICAL MATERIALS. Apt, K. E.; Gladney, E. S. (Los Alamos Scientific Lab., NM). Anal. Chem.; 47: No. 8, 1484(Jul 1975).

Recently a procedure was reported for the determination of noble metals in geological samples in which the sample is exposed to neutron activation followed by fusion with Na_2O_2 and NaOH. In an examination of this procedure quantitative determinations of the Os present could not be made. In a tracer technique study of the procedure it was determined that Os tends to oxidize to the volatile OsO_4 during the fusion/dissolution step. More serious losses occurred however when the dissolved melt was boiled with HNO_3 to destroy the peroxide. The effect on the analytical results if total procedural volatilization losses for Os standard samples are different from losses for geological Os samples is considered. (JSR)

13738 QUANTITATIVE DETERMINATION OF CHEMICAL ELEMENTS IN MULTICOMPONENT SAMPLES BY PHOTONEUTRON ANALYSIS. Guti, A. I.; Mel'nichenko, D. P.; Mazyukevich, N. P.; Parlag, A. M.; Shkoda-Ul'yanov, V. A. Sov. At. Energy (Engl. Transl.); 37: No. 5, 1179-1181(Nov 1974).

Translated from At. Energ. (USSR); 37: No. 5, 421-422(Nov 1975).

The work reported is an extension of that reported previously and tests the possibility of using a stable method of quantitative analysis of multicomponent mixtures based on experimentally determined photoneutron yields. The method was tested on a tungsten-rhenium alloy and on a tantalum-tungsten-rhenium alloy. (LK)

13739 POSSIBILITY OF USING PHENOLFORMALDEHYDE RESIN FOR INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF ROCKS. Leipunskaya, D. I.; Kolomiitsev, M. A.; Drynkin, V. I.; Belen'kii, B. V.; Dundua, V. Yu.; Pachuliya, N. V. Sov. At. Energy (Engl. Transl.); 37: No. 5, 1195-1196(Nov 1974).

Translated from At. Energ. (USSR); 37: No. 5, 431-432(Nov 1974).

The properties of phenolformaldehyde resin as a universal packing material for INAA analysis of various rocks with different elemental compositions and impurity element contents were studied. Specimens of granite gabbio-diorite, basalt, trap-rock, and graphite were analyzed and the concentrations found of Al, Na, Ce, Cr, Eu, La, Sc, Sm, Th, Mn, Fe, Co, Cs, Hf, Rb, Ta, and U are given. (LK)

13740 IN VIVO NEUTRON ACTIVATION ANALYSIS. Clinical Potential in Body Composition Studies. Cohn, S. H.; Ellis, K. J.; Wallach, S. (Brookhaven National Lab., Upton, NY). Am. J. Med.; 57: No. 5, 683-686(Nov 1974).

Elements currently routinely measured by this method are Ca, P, Na, Cl, and N. Sensitivity of the method and its limits of use are discussed. (21 references) (MCG)

13741 NON-DESTRUCTIVE ANALYSIS BY NEUTRON ACTIVATION OF REFRACTORY MATERIALS AND A GLASS. Chesneau, F.; Jerome, D. Y. (Paris-6 Univ., 75 (France)); Philippot, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Verres Refract.; 29: No. 1, 3-7(Jan 1975). (In French).

Six refractory samples containing alumina or zirconia and one sample of float-glass were analyzed by neutron activation. The radioactivity of the samples was measured by gamma spectrometry. 22 elements (Ca, Co, Cr, Fe, Ga, K, Na, Th, U, Zr and rare earths) were determined without chemical separation. This study of furnace materials, liable to cause defects, is a first step towards the use of a new technique for the determination of defects in glass. (FR)

13742 CADMIUM-FILTER, NEUTRON-ACTIVATION ANALYSIS FOR DETERMINATION OF PHOSPHORUS AND MAGNESIUM. Tomberlin, T. A.; Eckhoff, N. D. (Kansas State Univ., Manhattan (USA). Dept. of Nuclear Engineering). Nucl. Instrum. Methods; 125: No. 4, 549-552(1 May 1975).

A cadmium-filter, neutron-activation analysis technique was developed to analyze wheat samples for phosphorus. In this technique, the gamma rays from ^{28}Al, simultaneously produced from ^{31}P, ^{28}Si, ^{27}Al, and ^{26}Mg during a neutron irradiation, were used as the indicator for phosphorus. An "area-of-interest" unfolding technique was used in the analysis of each gamma-ray spectrum. Phosphorus concentrations varied from (1320 ± 96) ppm to (2976 ± 139) ppm. Concurrent analyses for magnesium content were also obtained. (auth)

13743 DETERMINATION OF IODINE IN BIOLOGICAL MATERIAL. Binnerts, W. T. (Agricultural University Coll., Wageningen, Netherlands); Das, H. A. Methods Biochem. Anal.; 22: 251-306(1974).

Methods for determining trace amounts of iodine in biological materials are discussed. Some of the methods are neutron activation analysis, catalysis of the Ce(IV)–As(III) reaction preceded by alkaline combustion, and catalysis of the Ce(IV)–As(III) reaction preceded by acid digestion and distillation. Methods for clinical analysis are also considered. (LK)

13744 PRELIMINARY OBSERVATIONS ON EXCRETION OF ^{37}Ar FROM MAN FOLLOWING WHOLE-BODY NEUTRON ACTIVATION: AN INDICATOR OF TOTAL-BODY CALCIUM. Lewellen, T. K.; Chesnut, C. H. III; Nelp, W. B.; Palmer, H. E.; Murano, R.; Hinn, G. M. (Univ. of Washington, Seattle). J. Nucl. Med.; 16: No. 7, 672-675(Jul 1975).

Measurements of exhaled ^{37}Ar produced by total-body neutron irradiation of ^{40}Ca were used to determine total-body calcium in 16 human subjects. There was a good correlation between body calcium using the 30-min postirradiation breath sample of ^{37}Ar and body calcium determined by measurement of ^{49}Ca. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 13896, 14787, and 15021.

13745 (ARH-ST-116) SPECTROPHOTOMETRIC DETERMINATION OF TRACE URANIUM IN PLUTONIUM NITRATE AND OXIDE WITH 2-(2-PYRIDYLAZO)-5-DIETHYLAMINOPHENOL. Winters, W. I. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2130. 67p. Dep. NTIS $5.45.

A spectrophotometric method for the determination of trace uranium in plutonium was developed and evaluated. Uranium was separated from plutonium in a 4M HCl-2M NH_2OH.HCl matrix with Aliquat-336. The uranium in the organic was determined by spectrophotometry using 2-(2-pyridylazo)-5-diethylaminophenol. The parameters for color development were evaluated. The effect of Pu on the U determination was examined for both Aliquat-336 and TOPO extractions. Three methods for preparing and dissolving PuO_2 samples for the analysis were studied and the effect of HCl, HF, and organic-to-aqueous ratio on the extraction determined. The spectrophotometric analysis of U in PuO_2 was compared with x-ray emission analysis of the same material. The average spectrophotometric result on U in PuO_2 was 100.4 ± 8.4 percent compared with 108.3 ± 2.5 percent for x-ray emission. Uranium analyses for an FFTF PuO_2 standard were bias 20 percent high for both techniques but had precisions of less than ±5 percent. Of the 33 ions tested, only palladium seriously interfered. Eight milliequivalents of HNO_3 can be tolerated by the Aliquat-336 uranium extraction. When no uranium extraction is necessary, a direct spectrophotometric method for measuring U levels between 1 and 10 mu g was examined. The spectrophotometric determination of U offers a sensitive and selective method for analyzing U in many nuclear materials. (auth)

13746 (BARC-767) GLOVE BOX SET-UP FOR ATOMIC ABSORPTION SPECTROPHOTOMETRY FOR THE RAPID ESTIMATION OF IMPURITIES IN URANIUM. Dhumwad, R. K.; Kulkarni, V. T.; Patwardhan, A. B. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.). 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

For the analytical application of atomic absorption spectrophotometry to alpha active solutions, a set-up with a glove box was designed and operated using Hilger and Watts model AA2/3 spectrophotometer. The salient features of the set-up are the isolation of atomizer and burner for the containment of alpha activity in the glove box, the removal of heat generated by the flame and the recovery of atomized radioactive materials. Consideration was given to the safety problems associated with the use of an air-acetylene flame inside a glove box and the atomization of large quantities of radioactive samples. A safety device was designed and used in the acetylene supply line. A method was standardized with a standard deviation of 3.6% for the estimation of seven impurities in uranium. The main advantage of this method is the absence of any chemical separation of the matrix prior to the analysis. The method not only rules out the possibility of additional errors due to separation procedure but also reduces the analysis time considerably. (auth)

13747 (BARC-774) SPECTROGRAPHIC DETERMINATION OF TWENTY-ONE TRACE IMPURITIES IN ALUMINUM METAL AND ALUMINA. Chandola, L. C.; Machado, I. J. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

An emission spectrographic method for the determination of twenty-one trace impurities in aluminium oxide is described. The sample is mixed with graphite powder as buffer in the weight ratio of 1 : 1 and loaded in to the cavity of a graphite electrode. The sample is excited as anode in a D. C. arc at 10 amperes current and spectra are recorded on an Ilford N.30 emulsion using a Large Quartz Spectrograph. A weak line of Al at 2669.2 Å is used as internal standard. The lower limits of determination are Ag, Bi, Cr, Cu, Mn, and Pb (5 ppM); B, Co, Fe, Ga, In, Mg, Mo, Ni, Sb, Sn, Ti, and V (10 ppM); Cd (20 ppM); Si (70 ppM); and Zn (100 ppM). The precision for eleven determinations at 50 ppM level varies from ± 5% for B to ± 22% for Cu. (auth)

13748 (BARC-779) POTENTIOMETRIC METHOD FOR THE ESTIMATION OF BORON IN REACTOR GRADE HEAVY (or light) WATER SAMPLES. Menon, K. R.; Namboodiri, E. G. A.; Vartak, D. G. (Bhabha Atomic Research Centre, Bombay (India). Reactor Operations Div.). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

A simple potentiometric titration method for the estimation of boron in reactor-grade heavy (or light) water is presented. The complex acid formed by sorbitol in dilute neutral boric acid solution is treated against standard alkali potentiometrically. The quantity of standard alkali used is a measure of the boron content in the solution. (auth)

13749 (BARC-783) SPECTROSCOPY DIVISION ANNUAL PROGRESS REPORT FOR 1973–74. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 127p. Dep. NTIS (US Sales Only) $9.50.

Emission spectroscopy was used for the following analyses: determination of boron in uranium and its oxides and in UF_4; analysis of semiconductor grade B_2O_3, of high-purity aluminium metal, and high-purity MoO_2; analysis of wear metals in lubricating oils; analysis of thallous iodide and of phosphorus compounds;

determination of boron in calcium fluoride, of trace elements in basalt rocks, and trace impurities in strontium carbonate; analysis of high-purity europium oxide; determination of iron in diammonium hydrogen phosphate; and analysis of rare earths in high-purity gadolinium oxide. X-ray fluorescence analysis was used for determination of HfO_2 in high-purity ZrO_2; analysis of Zn, Zr, and U in ThO_2; analysis of Sm, Eu, Gd, Dy, Ho, and Y in Tb_4O_7; determination of Nb, Ta, and Ti in ore concentrates; and determination of thorium in uranium. Status of work being done in atomic, molecular, and solid state spectroscopy and in optics is reported. (LK)

13750 (KFK-2097) NON-DESTRUCTIVE METHOD FOR THE DETERMINATION OF THE O/Me RATIO IN PLUTONIUM BEARING OXIDE FUEL. Vollath, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Mar 1975. 22p. (In German). Dep. NTIS (US Sales Only) $4.25.

This report introduces a new nondestructive method for the measurement of the oxygen-to-metal ratio in mixed oxide fuel. With a probability of 99.5% the error of this method is less than $\Delta O/Me = 0.005$. Furthermore, it is possible to automate this method. (auth)

13751 (REG/G-5.16(Rev.1)(5-75)) STANDARD METHODS FOR CHEMICAL, MASS SPECTROMETRIC, SPECTROCHEMICAL, NUCLEAR, AND RADIOCHEMICAL ANALYSIS OF NUCLEAR-GRADE PLUTONIUM NITRATE SOLUTIONS AND PLUTONIUM METAL. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). May 1975. 2p. NRC.

Controlled-potential coulometry and amperometric titration with iron(II) are used to determine plutonium nitrate solutions and plutonium metal. The latter is also determined by ceric sulfate titration. Precision and accuracy are given for each method. (LK)

13752 (UCID-15644-75-1) GENERAL CHEMISTRY DIVISION QUARTERLY REPORT, JANUARY-MARCH 1975. Harrar, J. E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 May 1975. Contract W-7405-Eng-48. 33p. Dep. NTIS $4.00.

The status is reported for various research projects in the Analytical Chemistry Division of the Lawrence Livermore Laboratory; including studies on laser spectroscopy of atomic uranium, isotope shift emission spectra of uranium and curium, and emission spectrum of einsteinium. (LK)

13753 RAPID DETERMINATION OF RHENIUM IN ALLOYS BASED ON MOLYBDENUM. Antonova, R. A.; Gedevanova, I. V.; Suvorova, S. N. Nauch. Tr., Vses. Nauch.-Issled. Proekt. Inst. Tugoplavkikh Met. Tverd. Splavov; No. 13, 130-133(1973). (In Russian).

The sample (0.2 to 0.3 g) is heated to fumes with H_3PO_4 (15 ml) and concentrated HNO_3 (2 to 3 ml); the cooled solution is then diluted to 250 ml, and a portion (2 to 20 ml) is passed (at 2 ml per min.) through a column (5.5 to 6 cm × 1 cm) of anionite EDE-10 washed with $2M-H_3PO_4$; the Re is then eluted with 30 ml of $2M-H_3PO_4$. To the eluate are added 5 ml of 10% thiourea solution and 2.5 ml of 10% $SnCl_2$ solution in HCl, the mixture is diluted to 50 ml with $2M-H_3PO_4$, and, after 35 to 40 min., the extinction is measured at 400 nm. The error is ± 10%. (Ref. Zh.)

13754 SPECTROPHOTOMETRIC DETERMINATION OF DI(2-ETHYLHEXL), DI(4-OCTYLPHENYL) AND MONO(4-OCTYL-PHENYL)PHOSPHORIC ACIDS WITH RHODAMINE-B. Bhattacharyya, K.; Murthy, T. K. S. (Bhabha Atomic Research Centre, Bombay). Anal. Chem.; 76: No. 1, 91-96(May 1975).

A spectrophotometric method for the determination of di(2-ethylhexyl)-, di(4-octylphenyl)-, and mono(4-octylphenyl)phosphoric acids is described. The method was applied for their determination in aqueous raffinates from uranium extraction process where they are employed as extractants. The reagent was a dichloroethane extract of rhodamine-B prepared from an aqueous phosphate buffer of pH 10. The organophosphoric acids were separated from the aqueous solution by extraction with dichloroethane and this organic extract was mixed with rhodamine-B reagent. The intense color produced had maximal absorbance at 560/565 nm. The molar absorptivity was about 10^5 in all cases. (NL)

13755 SPECTROPHOTOMETRIC DETERMINATION OF NITROGEN IN VANADIUM, TITANIUM, AND URANIUM WITH THYMOL AFTER ALKALI FUSION. Hashitani, H.; Yoshida, H.; Adachi, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki). Anal. Chem.; 76: No. 1, 85-90(May 1975).

Vanadium metal packed into a nickel boat with potassium hydroxide is fused at 500 to 600°C, and the volatilized ammonia is absorbed in dilute hydrochloric acid. The ammonia is converted to monochloramine with sodium hypochlorite at pH 9.8-10.3, and reacted with thymol at pH 11.5-11.9 for 1 h, and the absorbance is measured at 660 nm. The proposed method was also used for the determination of nitrogen in titanium and uranium. Nitrogen in some other metals such as Al, Be, In, Mg, Mn, Si, Sb, Sn, Ta, V, W and Zn which can be fused with potassium hydroxide and have melting points above 400°C may also be determined. (NL)

13756 MECHANISM OF ACTION OF NaCl AS CARRIER ON INTENSITY OF RARE EARTH ELEMENT LINES IN THEIR CHEMICAL-SPECTROGRAPHIC DETERMINATION. Laktionova, N. V.; Karyakin, A. V.; Ageeva, L. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 4, 703-707(Apr 1975). (In Russian).

The mechanism of action of a small NaCl additive (1%) was studied on increasing the intensity of rare earth element lines in a carbon collector. Chlorination of rare earth oxides with sodium chloride in the electrode crater is of a small thermodynamic probability. One percent NaCl decreases the integral plasma temperature by 600 ± 100°K while the electron pressure and ionization degree is increased by 2.5 times. The main contribution to increasing the rare earth line intensity is due to increasing their atom concentrations. An increase in the coefficient of using the sample vapors may be responsible for the carrier effect on the rare earth line intensity because of a significant increase in the pressure of NaCl vapor distilled. Chlorine atoms, which possess a large affinity to electrons, promote increasing the time rare earth atoms are present in the spectrum excitation zone. (auth)

13757 DIRECT COMPLEXONOMETRIC TITRATION OF THORIUM(IV), URANIUM(IV), NEPTUNIUM(IV), AND PLUTONIUM (IV) WITH DIETHYLENETRIAMINEPENTAACETIC ACID IN THE PRESENCE OF XYLENOL ORANGE AS INDICATOR. Rykov, A. G.; Piskunov, E. M.; Timofeev, G. A. Zh. Anal. Khim.; 30: No. 4, 713-716(Apr 1975). (In Russian).

A procedure is suggested of titrating Th(IV), U(IV), Np(IV), and Pu(IV) in acid solutions with diethylenetriaminepentaacetic acid solution in the presence of xylenol orange as indicator. (auth)

13758 REACTION BETWEEN MOLYBDENUM(VI) AND POTASSIUM BENZYLDITHIOCARBAMINATE DURING AMPEROMETRIC TITRATION. Galushko, S. V.; Usatenko, Yu. I. (Dnepropetrovsk Chemical-Technical Inst., USSR). Zh. Anal. Khim.; 30: No. 4, 750-754(Apr 1975). (In Russian).

Molybdenum(VI) reacts with potassium benzyldithiocarbaminate in a ratio 1:2. The reaction was examined. The ion product for MoO_2A_2 was determined. Conditions were studied for amperometric titration of molybdenum(VI). (auth)

13759 VOLTAMMETRY OF THE RUTHENATE DETERMINATION OF RUTHENIUM BY REACTION OF RUTHENATE ELECTROREDUCTION. Bardin, M. B.; Nguen Fyok Tkhan. (Kishinev State Univ., USSR). Zh. Anal. Khim.; 30: No. 4, 765-769(Apr 1975). (In Russian).

The possibility was studied of quantitative determination of ruthenium from the first wave of reducing ruthenium. The diffusion current is directly proportional to ruthenate concentration over the range 1.10^{-4} to 3.10^{-3}. Oxygen dissolved in the electrolyte as well as Rh(III) (1:4), Ir(IV) (1:6), Pd (1:8) do not interfere with ruthenium determination from the first wave of reducing ruthenium (limit ratios of elements are given in brackets). Pt(IV) and Os(VIII) interfere. The way of preliminary separation of ruthenium as RuO_4 does not effect on the first wave parameters. (auth)

13760 EFFECT OF NATURAL WATER MACROCOMPONENTS ON DETERMINATION OF MICROELEMENTS. Karyakin, A. V.; Pavlenko, L. I.; Safronova, N. S. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 4, 775-781(Apr 1975). (In Russian).

The effect of macrocomponents was examined on determination of microelements. The ⟨⟨thin layer⟩⟩ method and the ⟨⟨cup⟩⟩ method were developed for spectrographic determination of Mn, Fe, Pb, Co, Ni, Cu, Zn, Mo, Cr, Sn, and V in natural water. The procedures involve partial water evaporation from 6 to 30 times depending on water mineralization. The limit of detection varies between 1.10^{-2} and 5.10^{-4} mg/l (the value depends on the element determined). The relative standard deviation is between 0.1 and 0.25 (depending on the method used, element determined, and its concentration). (auth)

13761 FLUORIMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF URANIUM IN MEXICAN MINERALS AFTER PRELIMINARY SEPARATION BY SOLVENT EXTRACTION. Korkisch, J.; Abascal, F.; Carmen, A. P. (CNEN, Mexico City). Rev. Latinoam. Quim.; 4: No. 4, 185-189(1973).

The U (equivalent to 1 ppM to 0.2% of U_3O_8 in the mineral) is extracted from the sample solution (made M in HCl and containing

ascorbic acid to prevent co-extraction of Fe^{III}) by 0.1M trioctylphosphine oxide in ethyl acetate; the use of salting-out agents is avoided, and recovery is 99%. The determination is completed by a known fluorimetric method. (Anal. Abstr.)

13762 KINETIC POLAROGRAPHIC WAVE OF URANIUM IN THE PRESENCE OF CHLORATE IONS. Manok, G.; Varhelyi, C.; Kerecsendi, G. (Babes-Bolyai Univ., Cluj). Monatsh. Chem.; 104: No. 5, 1307-1314(1973). (In German).

The second polarographic wave of U(VI), due to the reduction of U(V) to U(III) is enhanced in the presence of ClO_3^-. Investigation of this was carried out with mixtures of $NaClO_3$ and $NaClO_4$ of constant ionic strength, at four temperatures, two concentrations of $HClO_4$ and in both the presence and absence of NaCl. The kinetic current is believed to result from the re-oxidation of U(III) to U(IV) by the ClO_3^-. The rate constants of this reaction and its activation enthalpy (10.35 kcal. per mole) were determined by Koutecky's method; the presence of NaCl decreases the kinetic current. It is proposed that the fivefold increase in waveheight in 2M-ClO_3^- could be of use in the determination of trace concentrations (μm to 10 μM) of U. (Anal. Abstr.)

13763 ION-EXCHANGE METHOD FOR SIMULTANEOUS MICROGRAM DETECTION OF SULFUR, CHLORINE, IODINE, AND NITROGEN IN ORGANIC COMPOUNDS. Qureshi, S. Z.; Rathi, M. S. (Aligarh Muslim Univ., India). Anal. Chem.; 47: No. 8, 1424-1425(Jul 1975).

A combination of the sodium fusion method and the resin spot technique was used successfully for the simultaneous detection of N, S, Cl, and I present in microgram quantities in organic mixtures. The addition of cation exchange resin beads to the sodium fusion yields a violet color if S is present. After complete removal of the S, the Cl is detected by the addition of exchange resin beads in the Ag^+ form. The presence of Cl will cause the formation of a white precipitate which rapidly turns black. The addition of a starch solution to the resin beads in the OH^- form induces a deep violet. After removal of the iodide ions the N is determined by the addition of copper sulfate, ammonium molybdate, and HCl which produces a deep color on the resin surface. (JSR)

13764 TITANIUM SUBLIMATION PUMP METHOD FOR THE DETERMINATION OF NOBLE GASES IN GAS MIXTURES. Baker, R. W.; Black, J. N.; Sengl, E. D.; Woltermann, H. A. (Monsanto Research Corp., Miamisburg, OH). Anal. Chem.; 47: No. 8, 1487-1489(Jul 1975).

A titanium sublimation pump method, based on the chemical gettering action of Ti to separate chemically active gases from inert gases, was developed. The residual rare gas was determined by a simple PVT calculation. The method was developed as a means for the accurate determination of the ^3He decay product in mixtures containing T_2 and HT. The equipment and procedure are described. The results of analyses of He in H_2 and of ^3He in T_2 are tabulated. To illustrate the versatility of the device and method analyses were also made of H_2 in Ar, CO in Ar, and CO_2 in Ne. (JSR)

13765 ANALYSIS OF PETROLEUM FOR TRACE METALS: A METHOD FOR IMPROVING DETECTION LIMITS FOR SOME ELEMENTS WITH THE GRAPHITE FURNACE ATOMIZER. Runnels, J. H.; Merryfield, R.; Fisher, H. B. (Phillips Petroleum Co., Bartlesville, OK). Anal. Chem.; 47: No. 8, 1258-1263(Jul 1975).

The detection limits with the HGA-70 graphite furnace atomizer can be improved by treating the inner surface of the furnace with a suitable carbide forming element such as lanthanum or zirconium. The carbide coating is stable for the normal useful life of the furnace and can be applied at the time of manufacture or after the furnace is installed in the atomizer. The coating prevents physical contact between the carbon of the furnace and subsequent samples and precludes further carbide formation by elements in the sample. The thermal characteristics of the furnace are not noticeably altered by the coating procedure. The improvement in detection limit is demonstrated for beryllium, chromium, manganese, and aluminum. (auth)

13766 ATOMIZATION IN GRAPHITE-FURNACE ATOMIC ABSORPTION SPECTROMETRY. Peak-Height Method vs. Integration Method of Measuring Absorbance: Heated Graphite Atomizer 2100. Sturgeon, R. E.; Chakrabarti, C. L.; Bertels, P. C. (Carleton Univ., Ottawa). Anal. Chem.; 47: No. 8, 1250-1257(Jul 1975).

The signal integration technique developed and reported earlier has been used for measuring atomic absorption signals generated by the Heated Graphite Atomizer 2100. Cd, Zn, Al, Sn, Cu, Mo, and V have been selected for this study. In theory, the integration method of measuring absorbance is superior to the conventional peak-height as the measure of absorbance. In practice, integration does offer some advantages over the peak-height method of measurement; absolute sensitivity is increased by a factor of 2- to 8-fold and the linear range of the working curves is increased by a factor of up to 2. This study shows the effect of the better cell geometry of the HGA 2100 (as opposed to the Carbon Rod Atomizer 63) on the integrated absorbance signals. Modifications to the Heated Graphite Atomizer 2100 which would improve the atomization conditions beneficial to the integration method of measuring are suggested. (auth)

13767 ATOMIZATION IN GRAPHITE-FURNACE ATOMIC ABSORPTION SPECTROMETRY. Peak-Height Method vs. Integration Method of Measuring Absorbance: Carbon Rod Atomizer 63. Sturgeon, R. E.; Chakrabarti, C. L.; Maines, I. S.; Bertels, P. C. (Carleton Univ., Ottawa). Anal. Chem.; 47: No. 8, 1240-1249(Jul 1975).

Oscilloscopic traces of transient atomic absorption signals generated during continuous heating of a Carbon Rod Atomizer model 63 show features which are characteristic of the element being atomized. This research was undertaken to determine the significance and usefulness of the two analytically significant parameters, absorbance maximum and integrated absorbance. For measuring integrated absorbance, an electronic integrating control unit consisting of a timing circuit, a lock-in amplifier, and a digital voltmeter, which functions as a direct absorbance x second readout, has been designed, developed, and successfully tested. Oscilloscopic and recorder traces of the absorbance maximum and digital display of the integrated absorbance are simultaneously obtained. For the elements studied, Cd, Zn, Cu, Al, Sn, Mo, and V, the detection limits and the precision obtained are practically identical for both methods of measurement. The sensitivities by the integration method are about the same as, or less than, those obtained by the peak-height method, whereas the calibration curves by the former are generally linear over wider ranges of concentrations. (auth)

13768 DETERMINATION OF RARE EARTH IMPURITIES IN HIGH PURITY URANIUM BY ISOTOPE DILUTION ANALYSIS. Chitambar, S. A.; Mathews, C. K. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). Z. Anal. Chem.; 274: No. 1, 9-11(Mar 1975).

An isotope dilution method for the determination of rare earth impurities in uranium has been developed and Ce, Nd, Sm, Eu and Gd were determined in uranium oxide samples. The method involves isotopic dilution with enriched isotopes of the rare earths being measured, followed by the separation of rare earths from uranium. A mass spectrometer with thermionic source was used to determine the relative isotopic abundances in each of these rare earths. All these five elements were analyzed selectively by preferential evaporation technique. Trace concentrations down to parts per billion range can be measured with good sensitivity and accuracy. (auth)

13769 QUANTITATIVE ANALYSIS OF COMPLEX TARGETS BY PROTON-INDUCED X RAYS. Reuter, W.; Lurio, A.; Cardone, F.; Ziegler, J.F. (IBM T.J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 46: No. 7, 3194-3202 (July 1975).

We have explored the potential of proton-induced x-ray spectroscopy as a quantitative analytical technique to determine the composition of a homogeneous complex target. Direct production of x rays by protons in the low MeV range was considered using the binary encounter approximation and published data on the atomic number dependance of the stopping power. Also included is a correction scheme for secondary excitation processes if radiation is generated in the target capable of fluorescence excitation. The formalism of the correction scheme is closely related to the one commonly employed in electron microprobe spectroscopy. Our data indicate that the accuracy achievable in IIXS is of the order of $\pm 5\%$, if one considers the two important corrections: (1) the difference in the stopping power properties of the composite target compared to the pure element target; (2) secondary excitation processes if required. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 13891, 14313, 14356, 14388, 14616, 14632, and 14793.

13770 (BARC-785) STUDY OF THE EFFECT OF SOME OF THE EXPERIMENTAL PARAMETERS ON THE X-RAY FLUORESCENCE DETERMINATION OF TRACES OF HAFNIA IN HIGH PURITY ZIRCONIA. Qurbani, J. M.; Khanna, P. P.; Agrawal, R. M. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

The effect of analytical lines $HfL\alpha_1$ or $HfL\beta_{1,6}$ or $HfL\beta_2$; scintillation or gas flow proportional detectors; fine or coarse Collimators, x-ray tube voltage, current, and power; and order of diffraction: I or II of analyzing crystal LiF (200) on the precision of the results and the sensitivity of the method in the x-ray fluorescence determination of traces of hafnia in high-purity sirconia

was studied. Philips semiautomatic x-ray spectrometer PW 1220 with associated equipment was used. Synthetic standards containing HfO_2 in the range 20 ppM to 1% in ZrO_2, presented as double layer pellets have been used. LiF (200) analysing crystal, tungsten target x-ray tube, automatic pulse height selection and pulse height discrimination were used in all the cases. The combination – "HfL $\beta_{1,5}$ analytical line, fine collimator and gas flow proportional counter detector" – gave the best performance. (auth)

13771 (CEA-R-4673) METHODS OF TRITIUM DETERMINATION IN GASEOUS MIXTURES, WATER AND NUCLEAR REACTOR MATERIALS. Chenion, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). May 1975. 22p. (In French). Dep. NTIS (US Sales Only) $4.25.

The tritium determination methods presented here apply to materials used in reactors. They enable tritium to be separated quantitatively from the other radioactive elements formed during fission. Tritium is measured in the form of tritiated water introduced into a Kinard scintillating solution; the activity of the mixture is measured by a liquid scintillation selector. These methods can be used to measure tritium in the following materials: reactor water, a wide variety of gaseous mixtures, solids as different as graphite, alloys, metallic oxides and carbides. For each analysis method described the overall precision of the measurement and the sensitivity limit are given. (auth)

13772 (ORNL-tr-2972) HIGH-RESOLUTION ALPHA SPECTROSCOPY WITH LIQUID SCINTILLATORS BY OPTIMIZATION OF THE GEOMETRY. Hanschke, T. 1972. Translation by Ernest G. Silver of German thesis. 72p. Dep. NTIS $6.75.

Thesis.

The use of alpha spectroscopy as a means of detecting contamination of the environment by a reactor installation is discussed. The natural radioactivity of a river water was determined as an example of alpha spectroscopy on samples with very low specific activity. (LK)

13773 RAPID SOLVENT EXTRACTION METHOD FOR THE DETERMINATION OF RADIO-IODINE IN SEA WATER. Flynn, W. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chem.; 76: No. 1, 113-119(May 1975).

A solvent extraction procedure for the determination of radioiodine in sea water is described. The water is treated with alkaline permanganate to remove algae and after removal of permanganate, the iodide is oxidized to iodine for extraction into toluene. The radioiodine with carrier is stripped from the solvent then re-extracted into a smaller volume of toluene for liquid scintillation counting and colorimetric determination of carrier recovery as iodine. 2-Methyl-1-butene is used to decolorize the toluene-iodine solution under uv light and avoid color quenching during counting. Samples spiked with ^{131}I showed essentially quantitative recovery from 1.01 of sea water with a typical recovery of 80 to 85% of carrier. The method is applicable in the presence of high concentrations of many foreign ions and the decontamination factor for a number of radionuclides is greater than 10^3. The limit of detection is less than 5.0×10^{-7} μCi/ml. (NL)

13774 METHOD OF SELECTIVE RADIOIODINE DETECTION IN THE PRESENCE OF GASEOUS FISSION PRODUCTS. Hladky, E.; Moravek, J.; Pietrik, I. Czech Patent 151,151. 20 Nov 1972. 7p. (In Czech).

Selective radioiodine detection in the presence of gaseous fission products is described. Radioiodine was adsorbed on alumina impregnated with $AgNO_3$, the sorption efficiency being better than 99.9%. The adsorbent was placed in a large-volume well-type scintillator. Its activity was measured within a defined energy range. (INIS)

13775 COMPUTATION OF LINE INTENSITIES FOR X-RAY FLUORESCENCE ANALYSIS. Verheijke, M. L.; Witmer, A. W. (Philips Gloeilampenfabrieken VN, Eindhoven, Netherlands). Philips Tech. Tijdschr.; 34: No. 11/12, 348-353(1974). (In Dutch).

The fundamental parameter method for calculating the element concentration from x-ray spectral line intensity was tested experimentally. The method was also used for finding favorable experimental conditions for the analysis of calibration samples. So far only K-lines can be used in this method. Systems studied were: Ag–Sn, Cu–Ag, Fe–Co–Ni, Cr–Fe–Ni, Cs–Br–H_2O. The fluorescence radiation was investigated both with wavelength dispersion (crystal spectrometer) and with energy dispersion [Si(Li)detector]. Monoenergetic gamma radiation (46.5 and 59.6 keV) from ^{210}Pb and ^{241}Am sources (10 mCi and 1 mCi, respectively) was used to effectuate excitation. Also secondary and tertiary excitation was examined. The computation method is given in an appendix. (NL)

13776 SOURCES OF ERROR IN COUNTING TRITIUM-LABELLED ADENOSINE AND GUANOSINE DERIVATIVES ON CHROMATOGRAM. Gulyassy, P. F. (Univ. of California, Davies). J. Chromatogr.; 105: No. 2, 401-404(26 Feb 1975).

13777 IMPROVED METHOD OF SILICON-32 MEASUREMENT OF GROUNDWATERS. Nijampurkar, V. N.; Somayajulu, B. L. K. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sect. A; 80: No. 6, 289-298(Dec 1974).

A rapid method of separation of ^{32}P from ^{32}Si by hydrofluorination saves considerable amount of time besides being more efficient in the chemical recovery of phosphorus. Similarly, 4π beta counting of ^{32}P activity allows a more accurate estimation of small amounts of this activity. These improvements make it possible to reliably measure amounts of ^{32}Si as low as 0.1 dpm present in about 10 tons of water. (auth)

13778 A NON-DESTRUCTIVE CHEMICAL ANALYSIS METHOD. Devienne, M.; Roustan, J. C. (to Agence Nationale de Valorisation de la Recherche (ANVAR), 92–Paris-Defense (France)). French Patent 2,212,044/D/. 22 Dec 1972. 11p. (In French).

This method comprises the steps of: bombarding a sample of the substance to be analyzed by means of a high-energy molecular jet so as to pulverize the surface thereof and extracting therefrom at least a certain amount of positive or negative ions, extracting and accelerating these ions by means of an electrostatic field of suitable direction and magnitude, introducing that ion-beam into a mass-spectrometer and carrying out the spectral analysis of the chemical substances forming that ion-beam. Application to the techniques of chemical analysis is made. (FR)

13779 MEASURING THE INCOMBUSTIBLE CONTENT OF MINE DUST USING BACKSCATTER OF LOW ENERGY GAMMA RAYS. Stewart, R. F.; Martin, J. W. (to Secretary of the Interior). US Patent 3,505,520. 7 Apr 1970. Filed Date 10 Oct 1967. 12p.

Low energy gamma radiation directionally applied in a method, and by an adjustable apparatus to a layer of mine dust produces scattered gammas whose reflected radiation detected at a predetermined distance from the mine dust acts to cause the generation of an electrical control input for a meter indicating the incombustible content of the mine dust substantially independently of the effects on such indicating which are normally due to its bulk density and any moisture content thereof. (auth)

13780 CERENKOV EFFECT IN THE ANALYSIS OF P-32 INCORPORATED INTO PROTEIN FRACTIONS SEPARATED ON POLYACRYLAMIDE GEL. Piantanelli, L.; Ermini, M.; Ricciotti, R. (Dipartimento Ricerche, Ancona, Italy). Boll. Soc. Ital. Biol. Sper.; 49: No. 20, 1127-1133(30 Oct 1973). (In Italian).

A method for the determination of the ^{32}P activity incorporated in protein fractions is described which does not use a scintillator material. The method is based on the direct measurement of the Cherenkov radiation after separation by electrophoresis on polyacrylamide gel. The quantity of water in the gel does not affect the analysis appreciably. The method requires no preliminary treatment of the sample and the results are independent of acid, base, or salt contamination. It is simple and very rapid. (JSR)

13781 COINCIDENCE AND NONCOINCIDENCE COUNTING (^{81}Rb AND ^{43}K): A COMPARATIVE STUDY. Ikeda, S.; Duken, H.; Tillmanns, H.; Bing, R. J. (Huntington Memorial Hospital, Pasadena, CA). J. Nucl. Med.; 16: No. 7, 658-661(Jul 1975).

The accuracy of imaging and resolution obtained with ^{81}Rb and ^{43}K using coincidence and noncoincidence counting was compared. Phantoms and isolated infarcted dog hearts were used. The results clearly show the superiority of coincidence counting with a resolution of 0.5 cm. Noncoincidence counting failed to reveal even sizable defects in the radioactive source. (auth)

Separation Procedures

Refer also to abstracts 13894, 13895, 13915, 13916, 16249, 16279, and 16282.

13782 (ANL-Trans-981) STUDY OF SOME CHROMATOGRAPHIC SUPPORTS FOR EXTRACTION. Chromatography of Uranium and Fission Products with Tributylphosphate. Hermann, A.; Hubener, S. Translated from J. Radioanal. Chem.; 21: 135-150(1974). 15p. Dep. NTIS $4.00.

Four chromatographic support materials from the production of GDR firms, one polytetrafluoroethylene support from USSR, polytrifluorochlorethylene and Myflo-Super-Cel were investigated for suitability under conditions of separation of uranium from other constituents of irradiated uranium fuel solutions with tributylphosphate as an extracting agent. Among the supports there is a new material developed in GDR on the basis of poly-

tetrafluoroethylene with some favorable properties. The experimental results are discussed in connection with the problem of comparison criteria for columns with supports differing in chemical nature, particle size and other parameters. Reduced plate height and velocity were used to arrange experiments under comparable conditions. The results indicate the fluorocontaining supports to be the most suitable ones from the investigated materials for the considered separation problem. (auth)

13783 (BARC-763) EXCHANGE OF METAL IONS ON A CHELATING EXCHANGER, DOWEX-AL. Iyer, S. G.; Venkateswarlu, C. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). 1974. 7p. Dep. NTIS (US Sales Only) $4.00.

Exchange of some metal ions was studied employing Dowex-Al in H^+ form as a function of the initial pH of the aqueous phase. Kd values of ZrO^{2+} at pH 2.0 and Th^{4+} at pHs 2-4 are lower than those on a carboxylic cation exchanger, while those of Ag^+, Ca^{2+}, Be^{2+} and UO_2^{2+} are higher. Metal ions which form stronger complexes with the chelating group viz. Ni^{2+}, Co^{2+}, Cu^{2+}, Al^{3+} and Th^{4+} (at pH 1.0 for this element) show much higher Kd values. Bi^{3+} is sorbed almost quantitatively on this exchanger also. (auth)

13784 (BARC-780) SEPARATION OF URANIUM AND THORIUM ON AMMONIUM PHOSPHOTUNGSTATE IN NITRIC ACID. Nadkarni, M. N.; Venkatasubramanian, V.; Mayankutty, P. C.; Pillai, N. S. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

Exchange behavior of uranium and thorium on ammonium phosphotungstate (APW) was investigated in nitric acid medium. Distribution coefficients were determined and exchange isotherms and break through profiles of thorium were studied. Suitable eluting agents were tested for the regeneration of the exchanger bed. The exchanger was found to exhibit favorable behavior for the separation of thorium and uranium in nitric acid medium. The results were tested by a series of column separations and the optimum feed compositions were suggested to yield the best results. Finally a separation scheme was worked out for the separation and purification of ^{233}U from its thorium contamination in the tail-end uranium solution from the Thorax reprocessing plant. (auth)

13785 (COO-1680-21) EXCHANGE OF INTERLAYER CATIONS IN MICACEOUS MINERALS. Progress Report, August 1, 1974–July 31, 1975. Scott, A. D. (Iowa State Univ. of Science and Technology, Ames (USA)). 1975. Contract AT(11-1)-1680. 16p. Dep. NTIS $4.00.

Information pertaining to the sorption and exchange of interlayer cations in micaceous minerals was developed along several lines. Cs sorption experiments with different minerals and particle sizes established the periods required for maximum sorption at different temperatures and downgraded the impact anticipated from a contraction of particle edges by Cs. Added interlayer Cs in even highly charged minerals (degraded muscovite) proved to be very exchangeable in air-dry, clay size particles. Heat treatments greatly retarded the exchange of this sorbed Cs and by doing so have circumvented the commonly observed small particle effects. Structural Fe in micas was shown to be susceptible to oxidation by various Br_2 treatments but these treatments also removed a lot of K that must be accounted for in a determination of changes in interlayer K exchangeability. Changes in the rate of interlayer K exchange were induced in some micaceous minerals by adding H_2O_2 but not in others. Specific effects of heat treatments on dioctahedral and trioctahedral micas were examined in great detail. Interlayer cation exchange experiments with different concentrations of Na and Al have produced predictable results. (auth)

13786 (GSI-J-2-74, pp 104-113) FAST CHEMICAL SEPARATION PROCESSES. Bruechle, W.; Claus, K.; Heimann, R.; Kaffrell, N.; Krebs, W.; Menke, H.; Schaedel, M.; Silva, R. J.; Stender, E.; Ahrens, H. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Fast chemical separation processes that work automatically in the wet chemical method are described. (GE)

13787 (IS-T-680) EXTRACTION OF METAL IONS WITH N, N-DISUBSTITUTED AMIDES. Orf, G. M. (Ames Lab., Iowa (USA)). Jul 1975. Contract W-7405-eng-82. 55p. Dep. NTIS $5.75.

Thesis.

Extraction of Al^{3+}, Ca^{2+}, Cd^{2+}, Cu^{2+}, Co^{2+}, Fe^{3+}, Hg^{2+}, Mg^{2+}, Ni^{2+}, Pb^{2+}, Th^{4+}, UO_2^{2+}, Zn^{2+}, and ZrO^{2+} from perchlorate solutions by N,N-Dibutylformamide (DBFA), N,N-Diethyldodecanamide (DEDA) and N,N-Dihexylacetamide (DHAA) was studied. Uranium, thorium, zirconium, and mercury were extracted to some extent by all three of the amides, but iron was extracted only by DBFA and DHAA. Lead was extracted only to a small extent by the formamide. The best extractant for the actinides appears to be DHAA, and for the other ions the formamide appears to be the superior extractant. (LK)

13788 (NP-20343, pp 8-12) VOLATILIZATION OF FISSION PRODUCTS FROM MOLTEN FLUORIDES. Weber, M.; Menke, H.; Trautmann, N. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13789 (NP-20343, pp 12-14) RAPID AUTOMATIC SEPARATION OF BROMINE AND IODINE FROM FISSION PRODUCTS. Nuh, F.; Prussin, S. G. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13790 (NP-20343, pp 14-17) RAPID SEPARATION OF YTTRIUM FROM FISSION PRODUCTS. Klein, G. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13791 (NP-20343, pp 23-26) RAPID SEPARATION OF NIOBIUM FROM FISSION PRODUCTS. Weis, M. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13792 (NP-20343, pp 27-29) RAPID SEPARATION OF MOLYBDENUM FROM FISSION PRODUCTS. Tittel, G. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13793 (NP-20343, pp 29-36) SEPARATION OF SHORT-LIVED RUTHENIUM NUCLIDES FROM FISSION PRODUCTS. Franz, G. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13794 (NP-20343, pp 36-38) SEPARATION OF SHORT-LIVED PALLADIUM ISOTOPES FROM FISSION PRODUCTS. Bruechle, W. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13795 (NP-20343, pp 38-42) DEVELOPMENT OF A RAPID SEPARATION METHOD OF CERIUM FROM FISSION PRODUCTS. Fischbach, G. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13796 (NP-20343, pp 91-94) CHEMICAL PROCESSING OF SUPERHILAC TARGETS. Kratz, J. V. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Liljenzin, J. O.; Seaborg, G. T. 15 Jun 1974. (In German).

In annual report, 1973. (Mainz Univ. Inst. fuer Anorganische Chemie und Kernchemie.)

13797 EFFECT OF DEGREE OF COLUMN LOADING ON BEHAVIOR OF RARE EARTH ELEMENTS IN EXTRACTION CHROMATOGRAPHY. Vassilev, H.; Faitondziev, L. P.; Havezov, I. P. (Chemical-Technical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 28: No. 1, 51-54(1975). (In Bulgarian).

The effect of degree of column loading was studied in the extraction chromatography of Nd with di-(2-ethylhexyl)phosphoric acid (HDEHP) from acid solution. The elution curves for Nd in elution with 0.625 and 0.360N HCl were experimentally determined for loading degrees from 5.9 to 35.5% of the theoretical capacity of the column. An analysis of the curves showed that with a given amount of HDEHP, there is a reduction of the distribution coefficient with increase of the degree of loading because of the decrease of the equilibrium concentration of HDEHP. A comparison of the elution curves of Nd with the curves for the HCl concentration in the filtrate showed that the minimum in the HCl curve corresponded to the maximum in the elution curve. (JSR)

13798 SORPTION EQUILIBRIUM OF THE CATIONS OF TRANSITION METALS FROM DILUTE SOLUTIONS OF THEIR SALTS BY THE ETHYLENEDIAMINETETRA-ACETATE FORM OF ANIONITE AV-17X2. Polyak, N. A.; Zimina, I. F. Vestsi Akad. Navuk BSSR, Ser. Khim. Navuk; No. 2, 69-71(1973). (In Russian).

In a study of the sorption of ions of Th, Hg, Cu, Ti(IV), Zn, Ag and Fe(III) on this form of the anionite from EDTA-containing

solution, it was found that all the ions had high affinity for the anionite, the distribution coefficient increasing as the stability constants of the EDTA complexes of the ions decreased (especially at low EDTA concentration in the solution); there was a rectilinear correlation between the log of the distribution coefficient and the pK of the EDTA complex for all the metals except Ag and Fe. Sorption on the resin from a solution 0.01 M in EDTA can be used to separate all the ions except those of Hg and Th. (Ref. Zh.)

13799 METHODS OF DETERMINATION OF SOME ELEMENTS OF NATURAL RADIOACTIVITY WHEN MONITORING PERSONS AND THE ENVIRONMENT. Separation of Radium by Ion Exchange and Separation of Polonium by Ion Exchange and by Extraction. Jerabek, V. (Inst. of Hygiene and Epidemiology, Prague). pp 129-137 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.) Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The possibilities of separating radium by ion exchange and separation of polonium by extraction and ion exchange are surveyed. Radium may be separated from the medium of mineral acids, by means of EDTA, utilizing organic acids and their salts and by paper chromatography or on the cellulose column. Polonium is separated by extraction in simple media of the aqueous and liquid phase, utilizing complexes in the organic phase and by high-molecular-weight amines. Ion exchangers are used for separation of polonium to a lesser extent. (auth)

13800 STUDY OF POSSIBILITIES OF ENHANCEMENT ON THE ION EXCHANGE SEPARATION METHODS. Szlaurova, M.; Koprda, V. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 291-298 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The possibility of accelerating the separation of radionuclides in mixed solvents by means of temperature changes of the exchange system and changes of the resin grain distribution span was studied. The experiments were carried out at 22, 35, and 55°C using an anion exchanger of grain size 200 to 400 mesh. Separation of $^{144}Ce-^{54}Mn$ and $^{89}Sr-^{60}Co-^{65}Zn$ in water–acetone–hydrochloric acid solvents was studied. Results show that the more narrow the resin grain distribution span and the higher the temperature the more rapid the separation process will be in general. (LK)

13801 SEPARATION AND QUANTIFICATION OF ^{32}P-LABELED GUANINE NUCLEOTIDES BY THIN-LAYER CHROMATOGRAPHY. White, A. A. (Univ. of Missouri, Columbia). J. Chromatogr.; 104: No. 1, 184-188(29 Jan 1975).

13802 A METHOD FOR THE SELECTIVE RE-EXTRACTION OF PLUTONIUM FROM ORGANIC SOLVENTS CONTAINING PLUTONIUM AND CONTINGENTLY, URANIUM THROUGH REDUCTION OF SAID PLUTONIUM. Cousinou, G.; Ganivet, M. (to CEA, 75 – Paris (France)). French Patent 2,212,611/A/. 28 Dec 1972. 13p. (In French).

The invention relates to a method for the selective re-extraction of plutonium from organic solvents containing plutonium and contingently uranium through reduction of said plutonium. The method consists in counter-current contacting the starting organic solvent, simultaneously with a reducing agent comprising an aromatic organic compound and with an agent adapted to eliminate the nitrites generated by said reducing agent and the other agent being introduced in the solution state. The method can be applied to the re-extraction of plutonium contained in tributylphosphate diluted in dodecane or in trilaurylamine. (FR)

13803 A METHOD FOR THE SELECTIVE RE-EXTRACTION OF PLUTONIUM FROM ORGANIC SOLVENTS CONTAINING PLUTONIUM AND CONTINGENTLY, URANIUM. Bathellier, A.; Germain, M. (to CEA, 75 – Paris (France)). French Patent 2,212,610/A/. 28 Dec 1972. 12p. (In French).

The invention relates to a method for the selective re-extraction of plutonium from organic solvents containing plutonium and contingently uranium. The method consists in causing the organic solvent to flow in counter-current with an aqueous solution of a hydroxylamine and formic acid salt. The method can be applied to the re-extraction of the plutonium of trilaurylamine diluted in an aromatic hydrocarbon, or to the separation of uranium and plutonium contained in tributylphosphate diluted in an aliphatic hydrocarbon. (FR)

13804 BEHAVIOR OF ION EXCHANGE RESINS TOWARDS CHLORIDES. Rozenberg, J.; Dolle, L.; Darras, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Recherche et Analyse). pp 78-80 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Water pollution by chloride ions liable to give rise to corrosion was observed when the water of a test loop, containing boric acid and lithium hydroxide, was purified by ion exchange resins. The reception test to check the anionic resins was examined. This test reveals insufficiencies and therefore an explanation using experimental results and a theoretical approximation of the breakthrough of chloride ions in ion exchange circuits has been tried. (FR)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 15475 and 15876.

Chemical and Physicochemical Properties

Refer also to abstracts 15388 and 16510.

13805 THE HIGH PRESSURE *PVT* PROPERTIES OF DEUTERIUM OXIDE. Fine, R.A.; Millero, F.J. (Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida 33149). J. Chem. Phys. 63: No. 1, 89-95 (1 July 1975).

The high pressure isothermal compressibilities of deuterium oxide from 5 to 100°C and 0 to 1000 bars applied or gauge pressure were determined from sound speed data. These compressibilities were used to derive an equation of state of the form $V^0P/(V^0 - V^P) = B + A_1P + A_2P^2$, where V^0 and V^P are the specific volumes at an applied pressure of zero and P; and B, A_1, and A_2 are polynomial functions of temperature. The compressibilities derived from this equation of state are consistent with those derived from the sound speed data to $\pm 0.016\times10^{-6}$ bar^{-1} over the entire pressure and temperature range (this is equivalent to $\sim$0.2 m sec^{-1} in sound speed). The 1 atm sound-derived compressibilities agree on the average to $\pm 0.06\times10^{-6}$ bar^{-1} with the direct measurements of Millero and Lepple. The *P–V–T* data from the sound-derived equation are compared with the high pressure work of Bridgman, Kesselman, Juza *et al.*, and Emmet and Millero. Good agreement (average deviation of $\pm 28\times10^{-6}$ cm^3 g^{-1}) was found with the recent specific volume measurements of Emmet and Millero. The *P–V–T* properties of D_2O are compared to pure water. D_2O and H_2O are shown to follow similar trends. Contrary to previous reports, the D_2O/H_2O ratios of the specific volumes and specific heats are shown to be functions of both temperature and pressure. (auth)

Isotope Effects

13806 (UUIP-878) ISOTOPIC AND VIBRONIC COUPLING EFFECTS IN THE ELECTRON SPECTRA OF $H_2{}^{16}O$, $H_2{}^{18}O$ AND $D_2{}^{16}O$. Karlsson, L.; Mattsson, L.; Jadrny, R.; Albridge, R. G.; Pinchas, S.; Bergmark, T.; Siegbahn, K. (Uppsala Univ. (Sweden). Fysiska Institutionen). Jul 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

Isotopic shift data for HeI-induced high resolution electron spectra of $H_2{}^{16}O$, $H_2{}^{18}O$, $D_2{}^{16}O$ are presented. From the differences in the vibrational subspectra adiabatic ionization energies and geometries of the ions were deduced and the excited vibrations assigned to normal modes. The ν_2 progression in the $^2A_1$ band was found to be affected by strong vibronic coupling. (auth)

13807 KINETIC PROPERTIES OF AN ENZYME HIGHLY ENRICHED IN CARBON-13. Eakin, R. T. (Univ. of Texas, Austin). Biochim. Biophys. Acta; 377: No. 1, 9-14(23 Jan 1975).

Two preparations of 6-phosphogluconate dehydrogenase from Candida utilis were obtained: one with 1.1 atom % ^{13}C (natural abundance), the other enriched with 90 atom % ^{13}C. The uv spectra of the two enzyme preparations were identical. Their activities were compared by measuring the accumulation velocity of NADPH; also the pH dependence of these activities. Finally the affinities of both enzyme preparations for $NADP^+$ and for 6-phosphogluconate were determined by measuring initial activities at different substrate concentrations. There was no difference in pH dependence. The activity and the affinity of the 90% ^{13}C-enzyme were slightly higher, but the magnitude of the difference is too small to ascribe it to an isotope effect with certainty. (auth)

13808 CATALYSIS BY TERTIARY AMINES IN REACTION OF SULFAMIDE FORMATION. Kinetic Isotope Effect. Litvinenko, L. M.; Maleeva, N. T.; Savelova, V. A. (Donetsk Dept. of Physical Organic Chemistry, USSR). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 11: No. 1, 225-238(Jun 1974).

A high catalytic activity of pyridine and N,N-dimethyl-p-

toluidine in the reaction of p-chlorobenzenesulfonic acid anhydride with m-nitroaniline in nitrobenzene at 25°C has been found. The intensity of catalytic action in reactions with anhydrides, bromides, and chlorides of arylsulfonic acids has been compared. The catalytic properties of tertiary and primary amines are correlated with the nature of the leaving group and the substrate. The kinetic hydrogen isotope effect has been shown to be absent on substituting the N-D-bond for the N-H-bond in the arylamine being acylated. From the experimental results the nucleophilic mechanism of catalysis has been assumed. (auth)

13809 MECHANISM OF THE PROCESS OF SULFAMIDE FORMATION. The Kinetic Isotope Effect. Litvinenko, L. M.; Maleeva, N. T.; Savelova, V. A.; D'yachkova, D. M.; Lopatinskaya, Kh. Ya. (Donetsk State Univ., USSR). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 11: No. 1, 213-223(Jun 1974).

The kinetics of the interaction between p-toluenesulfobromide and p-anisidine and its N,N-di-deuteroanalog in benzene, nitrobenzene and their 50 percent mixture (by volume) at 25°C has been investigated. The primary kinetic isotope hydrogen effect (when the N-H-bond is substituted by the N-D-bond) has been shown to be absent both in the noncatalytic reaction and in reaction catalyzed by the second amine molecule and by arylsulfanilide being formed. On the basis of this and a number of results previously obtained on the influence of structural effects and polar properties of medium on the rate of sulphamide formation, the general base catalysis mechanism without proton transfer in the rate limiting stage is discussed. (auth)

13810 EXCESS ULTRASONIC ABSORPTION IN WATER AND HEAVY-WATER MIXTURE. Narayana, K. L.; Swamy, K. M.; Murty, J. S.; Swamy, P. S. (Andhra Univ., Waltair, India). Nuovo Cim.; 25B: No. 1, 208-215(11 Jan 1975).

The excess ultrasonic absorption in binary mixtures of H_2O-D_2O has been evaluated by calculating the relaxation time (ν) and relaxing compressibility (β_r). There is good agreement between the computed and the experimental value of excess absorption using the above values of β_r and ν. ν and ΔF obtained from this method compare favorably with the values of the same parameters reported by Kor et al. in the lower-temperature range. In the higher-temperature range the difference is as high as 10%. This is because the values of β_∞ are assumed to be temperature independent by Kor et al. $\Delta V/V$ is found to be independent of temperature and concentration of D_2O supporting the assumption of earlier workers. (auth)

13811 SCANNING ISOELECTRIC FOCUSING IN SMALL DENSITY-GRADIENT COLUMNS. IV. The Use of Deuterium Oxide for Preparing the Density Gradient and Its Effects on Isoelectric Points of Proteins. Fredriksson, S. (Chalmers Inst. of Tech., Gothenburg, Sweden). J. Chromatogr.; 108: No. 1, 153-167(May 1975).

The use of deuterium oxide as a substitute for sucrose in preparing density gradients of small isoelectrofocusing columns was investigated. A density gradient was created in a 1.5-ml column by free inter-diffusion of three deuterium oxide solutions for 3 min. The resulting deuterium oxide concentration course (as shown by measurement of the refractive-index gradient) had a very high degree of linearity. Test runs with β-lactoglobulin and sperm-whale myoglobin showed that the strength and stability of the deuterium oxide density gradient should normally be sufficient for stabilization of protein zones against convection during isoelectric focusing. The isoelectric points of β-lactoglobulins A and B were found to increase as the concentration ratio of deuterium oxide to water at focusing level increased. Within the limits of experimental error, the pI shift corresponding to a given change in solvent composition was equal for both components. These findings are accounted for in terms of the deuterium isotope effect on the dissociation constants of protolytic groups and the shift in the asymmetry potential of the glass electrode in deuterium oxide as compared with water. The spontaneous reduction of sperm-whale metmyoglobin to ferrous myoglobin, which occurs on prolonged isoelectric focusing, is discussed, as are the benefits and drawbacks of deuterium oxide as a density-gradient solute. (NL)

13812 STRUCTURE-BREAKING AND STRUCTURE-PROMOTING PROCESSES IN AQUEOUS SOLUTIONS. Ben-Naim, A. (National Institutes of Health, Bethesda, MD). J. Phys. Chem.; 79: No. 13, 1268-1274(19 Jun 1975).

A new measure is devised to estimate the structural changes in the solvent induced by processes occurring in aqueous solutions. This measure relates the isotope effect in the standard free energy of the process involved, in light and heavy water, with the change in the average number of hydrogen bonds that occurs in the solvent. Some numerical examples for the process of dissolution are presented, from which one can classify solutes as either structure promoters or structure breakers. A possible generalization of this method for more complicated processes is also indicated. (auth)

13813 ISOTOPE EFFECT IN DIFFUSION OF PERDEUTERIOBENZENE AND ^{14}C-SUBSTITUTED BENZENES IN UNLABELED BENZENE AT 25°. Shankland, I. R.; Dunlop, P. J. (Adelaide Univ.). J. Phys. Chem.; 79: No. 13, 1319-1320(19 Jun 1975).

Mutual diffusion coefficients, obtained with a Gouy diffusiometer, are reported for the system perdeuteriobenzene–benzene (C_6D_6–C_6H_6) at 25°. These results are consistent with tracer diffusion coefficients which have previously been obtained in this laboratory for ^{14}C-substituted benzenes of varying molecular weight in benzene. Because of the small difference in refractive index between C_6D_6 and C_6H_6 only a limited range of concentrations was studied, and thus it was not meaningful to extrapolate the mutual data to give tracer diffusion coefficients. (auth)

13814 EQUILIBRIUM ISOTOPE EFFECTS IN AQUEOUS SYSTEMS. IV. The Vapor Pressures of NaBr, NaI, KF, Na_2SO_4, and $CaCl_2$ Solutions in H_2O and D_2O (0 to 90°C). Vapor Pressures of $Na_2SO_4 \cdot 10H_2O$, $\cdot 10D_2O$, and $CaCl_2 \cdot 2H_2O$, $\cdot 2D_2O$. Jakli, Gy.; Chan, T. C.; Van Hook, W. A. (Univ. of Tennessee, Knoxville). J. Solution Chem.; 4: No. 1, 71-90(1975).

Solvent vapor pressure isotope effects have been measured in HOH/DOD between approximately 0 and 90°C on the following electrolyte solutions: NaBr (2, 5, 7, and 9 m), NaI (4, 6, 8, and 10 m), KF (3, 6, 9, and 12 m), Na_2SO_4 (2 m and saturated solutions, and hydrated crystal), and $CaCl_2$ (3, 5.5, 8, and 10 m, and hydrated crystal). Values of the isotope effects on the various excess thermodynamic properties of solution, including the osmotic and activity coefficients and the excess free energies, enthalpies, and entropies, have been extracted from least-square expressions which fit the VPIF over the entire concentration and temperature range. The results are compared with those obtained for alkali metal chloride solutions (I, II) and literature data where possible. They are discussed briefly in terms of solution structure. (auth)

13815 SCALED-PARTICLE THEORY AND SOLVENT ISOTOPE EFFECTS ON THE THERMODYNAMIC PROPERTIES OF INERT SOLUTES IN WATER AND METHANOL. Philip, P. R. (Ministere de la Qualite de la Vie, Neuilly, France); Jolicoeur, C. J. Solution Chem.; 4: No. 2, 105-125(Feb 1975).

The scaled-particle theory has been applied to the calculation of the thermodynamic changes associated with the formation of a cavity in several isotopic varieties of liquid water and methanol. From these results, the thermodynamic functions for the transfer of a cavity (or a hard-sphere solute) have been computed for the following solvent pairs: H_2O yields D_2O, H_2O yields $H_2{}^{18}O$, $H_2{}^{18}O$ yields $D_2{}^{18}O$, D_2O yields $D_2{}^{18}O$, CH_3OH yields CH_3OD. For the last two of these solvents, density measurements required for the calculations were carried out as a function of temperature. The calculated deuterium solvent isotope effect on the heats and entropies of hard-sphere solutes in water is much greater than the ^{18}O isotope effect; the former also exhibits a more pronounced temperature dependence. The transfer functions computed for hard-sphere solutes are compared to experimental data on the transfer of various solutes from H_2O to D_2O and from CH_3OH to CH_3OD. In most of the cases examined, the cavity effect accounts for a large part of the transfer quantities measured for rare gases, hydrocarbons, and solutes containing a significant hydrocarbon substituent. (auth)

13816 I. EXPERIMENTAL AND THEORETICAL INVESTIGATION OF NON-EQUILIBRIUM KINETIC ISOTOPE EFFECTS IN CHEMICALLY ACTIVATED ETHYL RADICALS. II. A KINETIC INVESTIGATION OF THE REACTIONS OF ATOMIC HYDROGEN AND DEUTERIUM WITH SILANE AND MONO-, DI-, AND TRIMETHYLSILANE CONDUCTED IN A DISCHARGE FLOW SYSTEM WITH MASS SPECTROMETRIC DETECTION. Cowfer, J. A. Pittsburgh, PA; Carnegie-Mellon Univ. (1975). 187p. University Microfilms Order No. 75-12,500.

Thesis (Ph. D.).

The reactions of thermal H and D atoms with C_2D_4 and of D atoms with C_2H_4 were studied in helium diluent at room temperature with a discharge flow system time-of-flight mass spectrometric apparatus. Absolute measurements of the apparent bimolecular rate constants are obtained, under atom excess conditions, as a function of pressure for the reactions $D + C_2H_4$, $H + C_2D_4$, and $D + C_2D_4$. The variation in overall mechanism for the mixed isotope cases, ethyl-d, and ethyl-d_4, and the non-equilibrium kinetic isotope effects for chemically activated ethyl radicals are presented and compared with other work. Molecular models and all pertinent parameters for the three isotopically modified cases are consistently derived from the final parametric assignments of the completely protonated case, and the theoretically predicted fall-off curves for the deuterated systems are compared with the experimentally observed behavior. The reactions of H and D with silane

and with mono-, di-, and trimethylsilane were also studied in helium diluent at room temperature with the discharge flow apparatus. Absolute rate constants were measured for atom depletion in reactant-rich systems and for reactant depletion in atom-rich systems, and the overall stoichiometry factors are estimated. Mechanisms are proposed for these eight reactions which invoke considerable atomic cracking through chemical activation. The theoretical basis for this result is qualitatively discussed, and the observed kinetic isotope effects for hydrogen atom abstraction are also compared with theoretical estimates by the BEBO method. (Diss. Abstr. Int., B)

13817 ISOTOPIC EFFECT IN THE ABSORPTION SPECTRA OF NAPHTHALENE CRYSTAL. Sheka, E. F. (AN SSSR, Chernogolovka. Inst. Fiziki Tverdogo Tela); Terenetskaya, I. P. (AN Ukrainskoj SSR, Kiev. Inst. Fiziki). Chem. Phys.; 8: No. 1, 99-111(Apr 1975).

The absorption spectra of the naphthalene (d_0) and deuteronaphthalene (d_8) crystals were investigated at 4.2K. It was established that in the d_8-crystal spectrum compared with the d_0-crystal spectrum: (1) the integral spectrum intensity decreases by 1.5-fold on the average over the three first vibronic transitions; (2) the full Davydov splitting in the series of vibronic transitions with a totally symmetrical vibration decreases but the Davydov splitting for the (0,0) transition remains the same; (3) a change in the shape of the vibronic bands occurs which is connected with a change in the intramolecular parameters of the electron-vibration interaction. (4) a decrease in exciton- and vibron-phonon interaction occurs. The possible reasons for these changes are discussed. The results obtained are analyzed with respect to the use of the isotopic effect as a method of investigation of the electronic and vibronic spectral structure. (auth)

13818 ON THE COMPENSATION OF A NONUNIFORM CHEMICAL (MONOPOLE) SHIFT OF THE MOESSBAUER LINE. Gol'danskii, V. I.; Karyagin, S. V. (AN SSSR, Moscow. Inst. Fizicheskoj Khimii); Namiot, V. A. (Moskovskij Gosudarstvennyj Univ. (USSR). Inst. Yadernoj Fiziki). J. Phys. (Paris), Colloq.; No. 6, 193-196(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The proportionality between small variations of total S-electron density and spin density at the site of nucleus location permits proposing a method of compensating by a properly chosen radio-frequency field the most essential source of Moessbauer line broadening: the non-uniform chemical (Monopole) shift. The proposed method for narrowing the Moessbauer lines can be used for a precise determination of certain HFS parameters and for starting the operation of a γ-laser (gaser). It is also important for the extension of Moessbauer spectroscopy to all problems, which need much narrower lines (probably, up to the minimum width of solid state NMR line, i.e., 10^{-15} eV). (FR)

13819 VIBRATIONAL FREQUENCY CHANGE AND DEUTERIUM ISOTOPE EFFECTS. Al-Sader, B. H. (Univ. of Baghdad). Bull. Coll. Sci., Univ. Baghdad; 15: 91-98(1974).

From 4th conference of the Iraqi Chemical Society; Baghdad, Iraqi (18 Sep 1973).

Model calculations of α-deuterium isotope effect in the thermoanalysis of 1-pyrazoline were carried out following Streitwieser's analysis. The following observations were obtained from these calculations: (a) Frequency change produced by the twisting vibration at the transition state has a significant contribution to the secondary α-isotope effect and (b) the method of "isolated vibration" was shown to be unsuccessful in predicting the magnitude of secondary α-deuterium isotope effect. (auth)

13820 NITROGEN AND CHLORINE NQR IN PARAELECTRIC AND FERROELECTRIC TRIS-SARCOSINE CALCIUM CHLORIDE. Blinc, R.; Mali, M.; Osredkar, R.; Seliger, J. (Institute "J. Stefan," University of Ljubljana, Ljubljana, Yugoslavia). J. Chem. Phys. 63: No. 1, 35-37 (1 July 1975).

The pure nuclear quadrupole resonance spectra of ^{14}N have been measured in tris-sarcosine calcium chloride (TSCC), deuterated TSCC, and sarcosine using nuclear double resonance in the laboratory frame. In TSCC two chemically nonequivalent nitrogen sites have been found at room temperature, one with a quadrupole coupling constant e^2Qq/h =1040 kHz and an asymmetry parameter η=1 and another one with e^2Qq/h = 940 kHz, η=1. The ^{14}N results in deuterated TSCC differ from those in undeuterated TSCC by less than 10%. The corresponding ^{14}N data for sarcosine are e^2Qq/h = 1440 kHz, η=1 and e^2Qq/h = 1470 kHz, η=0.79. In the ferroelectric phase at 77 °K only one nitrogen site has been found in TSCC with e^2Qq/h = 1010 kHz and η=0.89. In TSCC, ν (^{35}Cl) =2160 kHz and ν (^{37}Cl) =1710 kHz, and deuterated TSCC ^{35}Cl and ^{37}Cl quadrupole resonance lines were found in the paraelectric phase, whereas in the ferroelectric phase no chlorine lines could be observed. (auth)

13821 ENERGY GAP LAW FOR VIBRATIONAL RELAXATION OF A MOLECULE IN A DENSE MEDIUM. Nitzan, A. (Department of Chemistry, Northwestern University, Evanston, Illinois 60201); Mukamel, S.; Jortner, J. J. Chem. Phys. 63: No. 1, 200-207 (1 July 1975).

In this paper we advance a model Hamiltonian for direct vibrational relaxation of a guest molecule in a host lattice. General expressions for the vibrational relaxation rate constant are derived utilizing the generating function method, elucidating the gross features of this class of multiphonon relaxation phenomena. Explicit theoretical results were obtained for the vibrational relaxation rate in two temperature regions: for moderately low temperatures below the characteristic Debye temperature and in the high temperature limit. In the low temperature range the vibrational relaxation rate exhibits a nearly exponential variation with the order of the multiphonon processes, revealing the energy gap law, an appreciable isotope effect, and a strong temperature dependence. The predicted energy gap law is compatible with the available experimental data. (auth)

13822 EFFECTS OF OXYGEN-18 SUBSTITUTION UPON ELECTRONIC RELAXATION IN THE $^3B_1$ STATE OF SO_2. Nelson, G.E.; Borkman, R.F. (School of Chemistry, Georgia Institute of Technology, Atlanta, Georgia 30332). J. Chem. Phys. 63: No. 1, 208-211 (1 July 1975).

We have measured phosphorescence lifetimes and quantum yields of solid $S^{16}O_2$ and $S^{18}O_2$ at several temperatures. Isotopic substitution was found to increase the phosphorescence lifetime of the $^3B_1$ state of solid SO_2 at 77 °K from 1.0±0.1 msec to 1.3±0.1 msec, and at 4.2 °K from 8.7±0.1 msec to 9.7±0.4 msec. The quantum yield of solid SO_2 at 77 °K was determined to be 0.09±0.01 and at 4.2 °K was determined to be no less than 0.6±0.1. Radiative and nonradiative rate constants for $^3B_1 \rightarrow {}^1A_1$ relaxation were calculated from our quantum yield and phosphorescence lifetime data. The nonradiative relaxation rate constant was found to be temperature dependent as well as isotope dependent, decreasing by a factor of 20 between 77 and 4.2 °K. At 1.4 °K, where the spin-lattice-relaxation rate is considerably reduced, three lifetime components could be resolved, and the phosphorescence decay time for the dominant spin state τ_1 was found to be longer for $S^{18}O_2$ than for $S^{16}O_2$, consistent with our observations at higher temperatures. (auth)

13823 INTERMOLECULAR POTENTIALS AND ISOTOPE EFFECTS FOR MOLECULAR HYDROGEN-INERT GAS COMPLEXES. Kreek, H.; Le Roy, R.J. (Guelph Waterloo Centre for Graduate Work in Chemistry, Department of Chemistry, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1). J. Chem. Phys. 63: No. 1, 338-344 (1 July 1975).

An exact power series expansion is derived which interrelates the coefficients of the Legendre expansions for an atom–diatomic molecule potential function expanded about the centers of mass of two different isotopes of the diatomic. Its application to the anisotropic potential recently obtained for H_2– and D_2–Ar yields a potential for HD–Ar, which is then used to predict the transition frequencies in the infrared absorption spectrum of the latter. The relatively large discrepancies between these predictions and the recent measurements of McKellar [J. Chem. Phys. 61, 4636 (1974)] are attributed to the unusual sensitivity of such predictions to the shape of the isotropic potential in the region between its minimum at $R_e^{(0)}$ and its zero energy turning point, $\sigma^{(0)}$. (auth)

13824 VIBRATIONAL ENERGY TRANSFER BETWEEN DF(v=2) AND CO_2. Hinchen, J.J.; Hobbs, R.H. (United Aircraft Research Laboratories, East Hartford, Connecticut 06108). J. Chem. Phys. 63: No. 1, 353-357 (1 July 1975).

Rates have been determined for the transfer of vibrational energy between DF(v=2), DF(v=1), and CO_2 using a laser-induced fluorescence technique. DF, in DF–CO_2 gas mixtures, was excited to both the v=1 and v=2 vibrational levels by absorption of radiation from a pulsed DF laser operating simultaneously on v (1–0) and v (2–1) transitions. By monitoring fluorescence intensity at 1.7, 3.5, and 4.4 μ, the temporal behavior of DF(v=2), DF(v=1), and CO_2 (001) populations was followed. A computer program was used to solve the differential rate equations and a "best fit" with experimental data determined the rate parameters. Rate constants obtained in this manner from the fluorescence data are k=5.1×10^5 sec^{-1}·torr^{-1} for the DF(v=2) →CO_2 transfer and k=1.5×10^4 sec^{-1}·torr^{-1} for CO_2 (001) deactivation by DF. (auth)

13825 RAMAN STUDIES OF ROTATIONAL AND VIBRATIONAL RELAXATION IN LIQUID FLUOROFORM. DeZwaan, J.; Hess, D.W.; Johnson, C.S. Jr. (Kenan Laboratories of Chemistry, University of North Carolina, Chapel Hill, North Carolina 27514). J. Chem. Phys. 63: No. 1, 422-426 (1 July 1975).

The rotational correlation functions and correlation times have been determined for liquid fluoroform from 135 to 296 °K by using depolarized Raman light scattering. Both the $\nu_1(A_1)$ hydrogen stretching mode and the $\nu_2(A_1)$ deformation mode were analyzed and found to give comparable results for the reorientational motion. The temperature

dependence of the reorientational correlation times obtained can be described by an activation energy of 0.97 kcal/mole, and a comparison of these times with previously reported values of the deuterium spin–lattice relaxation times in CDF_3 establishes a deuterium quadrupole coupling constant of ± (159±5) kHz. The isotropic linewidths of the $\nu_1(A_1)$ mode, which were found to be unusually large and completely insensitive to temperature, are reported and compared with the isotropic linewidths of the same vibrational mode in CDF_3. (auth)

13826 ABSTRACTION VERSUS EXCHANGE IN THE REACTION OF D WITH HBr. Su, H.Y.; White, J.M. (Department of Chemistry, The University of Texas at Austin, Austin, Texas 78712). J. Chem. Phys. 63: No. 1, 499-504 (1 July 1975).

The photolysis of $HBr–D_2–Br_2$ mixtures at 185 nm has been investigated and the results have been analyzed to provide limits for hot deuterium atoms on the ratio of abstraction ($D^* + HBr \rightarrow^{k_8} DH + Br$) to exchange ($D^* + HBr \rightarrow^{k_9} DBr + H$). For the hot deuterium atoms employed in these experiments, the ratio k_8/k_9 lies between 0.7 and 1.5. The results of quasiclassical trajectory calculations are shown to be in fairly good agreement with this experimental result. Comparison is made with a recent 300 °K thermal value of 3.2. Using molecular beam data for the exchange reaction cross section (1–10 Å^2) we estimate the abstraction reaction cross section is of the same order of magnitude and lies in the range 0.2–15 Å^2. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 14785.

13827 (CEA-N-1746, pp 138-139) THE ISOTOPE SEPARATOR ISERE: COMPARATIVE EVALUATION OF U ISOTOPE SEPARATION. Dousson, S. 1974. (In French).

In First semi-annual progress report 1974. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

The pumping system of the isotope separator was improved and two collections of ^{238}U carried out before and after the modification were compared. The results obtained bear out the interest of the modifications. (FR)

13828 (SUNI-37, pp 23-24) ISOTOPIC ANALYSIS OF BORON BY THE COINCIDENT MEASUREMENT OF COMPLEMENTARY PARTICLES (CMCP). Coetzee, P. P.; Pretorius, R.; Peisach, M. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

13829 ISOTOPIC COPPER EXCHANGE IN PILA HAEMOCYANIN WITH THREE RADIOACTIVE CUPROUS COMPLEXES. Cox, J. A.; Elliott, F. G. (Univ. Nationale de Zaire, Kinshasa, Belgium). Biochim. Biophys. Acta; 371: No. 2, 392-401(18 Dec 1974).

Isotopic copper exchange in Pila leopoldvillensis haemocyanin was studied with $^{64}Cu(II)$ acetate and with three $^{64}Cu(I)$ complexes, including a separation of excess copper with Chelex-110 chelating resin. With $^{64}Cu(II)$ acetate and with $^{64}Cu(I)$-acetonitrile complex the radioactive copper incorporation into oxygenated haemocyanin was found to be very small. With $^{64}Cu(II)$ acetate in the presence of KCN at the utmost 41% of the copper content of haemocyanin was replaced by the radioactive isotope. The experiments with $K_3{}^{64}Cu(CN)_4$ at different concentrations indicated that a reversible isotopic exchange reaction occurred with only half of the protein copper. Deoxygenation of haemocyanin had no influence upon the rate and extent of copper exchange. The copper band decreased linearly as a function of copper exchange and almost disappeared when the copper exchange approached 50%. Likewise with $^{64}CuCl_2^-$, in the absence of O_2, only half of the protein copper is exchangeable. The rate of exchange with $^{64}CuCl_2^-$ is, however, much faster than with cyanocuprate. (INIS)

13830 ISOTOPE EXCHANGE AT THE ACTIVE METHYLENE GROUPS IN COORDINATED MALONATE IN THE [COENMAL$_2$]-ION. Farago, M. E.; Smith, M. A. R. (Bedford Coll, London). Inorg. Chim. Acta; 14: No. 1, 21-23(Jul 1975).

Each malonato ligand has two protons in the methylene group; one in the H_B position, between the malonato rings, and the other in the H_A position, near to the ethylenediamine group. In D_2O/D_2SO_4 mixtures these undergo exchange with deuterium. The protons in the H_B positions are replaced first, $\Delta H^{2+} = 26.4$ kcal mol^{-1}, $\Delta S^{2+} = +26$ e.u. The protons in the H_A positions are replaced more slowly, $\Delta H^{2+} = 26.4$ kcal mol^{-1}, $\Delta S^{2+} = +22$ e.u. There is only a small degree of stereospecificity, which is discussed in terms of the conformational mobility of the malonato ring, the proximity of the neighboring groups, solvation effects, and of the possibility of a non-stereospecific reaction path. (auth)

13831 HOMOMOLECULAR ISOTOPE EXCHANGE IN OXYGEN CATALYZED BY SILVER WITH ADDITIONS OF SELENIUM. Kayumov, R. P.; Kul'kova, N. V.; Temkin, M. I. (Scientific-Research Physico-Chemical Inst., Moscow). Kinet. Catal.; 15: No. 5, 1193-1194(May 1975).

Translated from Kinet. Katal.; 15: No. 5, 1349-1350(1974).

The homomolecular exchange of oxygen was studied on silver with additions of small amounts of selenium. The rate constants decrease as the selenium concentration is increased, the activation energy decreasing in this case. This result is explained by the decrease in the strength of the bond between oxygen and silver. (auth)

13832 ISOTOPE EXCHANGE OF HYDROGEN IN SUBSTITUTED METHANES AND RELATED COMPOUNDS. Zatsepina, N. N.; Tupitsyn, I. F.; Belashova, A. I. (State Inst. of Applied Chemistry, Leningrad). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 11: No. 2, 431-444(Oct 1974).

Kinetics of the base-catalyzed deuterium exchange of aliphatic CH bonds in halogen derivatives of saturated hydrocarbons, α-substituted benzyls, some organosulfur and organophosphorus compounds is studied. It is shown that the change of kinetic CH-acidity of the studied compounds and of most other substituted methanes (with kinetic data available in literature) is rendered satisfactorily by means of σ^--values of substituents. (auth)

13833 BASE-CATALYZED DEUTERIUM EXCHANGE IN SOME ORGANOPHOSPHORUS AND ORGANOARSENIC COMPOUNDS. Zatsepina, N. N.; Tupitsyn, I. F.; Alipov, B. B.; Belashova, A. I.; Kirova, A. V.; Kolodina, N. S. (State Inst. of Applied Chemistry, Leningrad). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 11: No. 2, 445-463(Oct 1974).

On the bases of the results of investigation of kinetics of the deuterium exchange of alkyl and alkylphenyl derivatives of phosphine, arsine, their oxides, sulfides, phosphonium and arsonium salts, which are supplemented with measurements of infrared and proton magnetic resonance spectra the analysis of the influence of electronic effects of substituents and medium on kinetic CH-acidity of organophosphorus and organoarsenic compounds is made. (auth)

13834 ELECTRON SPIN RESONANCE STUDY OF ^{17}O ENRICHED N,N-DIMETHYL-4-NITROANILINE RADICAL ANION. Gulick, W. M.; King, V. J.; Miller, C. (Florida State Univ., Tallahassee). Mol. Phys.; 29: No. 5, 1431-1439(May 1975).

N,N-dimethyl-d_6-4-nitroaniline enriched to approximately 11 at. % in oxygen-17 was prepared and the oxygen-17 isotropic hyperfine interaction in the corresponding radical anion was examined. In dry dimethylformamide solution $a_0 = -8.85 \pm 0.02$ and $a_N = 11.39 \pm 0.10$ Gauss, while in moist acetonitrile solution $a_0 = -8.82 \pm 0.07$ and $a_N = 12.23 \pm 0.11$ Gauss. These results substantiate the recent suggestion that the isotropic oxygen-17 splittings in π-radicals may be described by a single parameter equation analogous to McConnell's relation for aromatic proton splittings, i.e., $a_0 = Q_0\rho^\pi_0$, where $Q_0 = -41 \pm 3$ Gauss. (auth)

13835 RELAXATION TIME OF THERMAL DIFFUSION COLUMNS WITH NONACTIVE VOLUMES. Madariaga, J.A. (Facultad de Ciencias, Universidad de Bilbao, Bilbao, Spain); Saviron, J.M.; Brun, J.L.; Mendia, M.D. J. Chem. Phys. 63: No. 1, 154-156 (1 July 1975).

Analytical solutions for the time evolution of the separation factor Q of an isotopic binary mixture in a thermal diffusion column with small reservoirs (dead spaces) at its ends are given. The simple expression obtained is checked against the numerical solution of the evolution differential equation. This shows its reliability to predict the nonstationary separation factor of a column with dead spaces up to 40% of its active volume, and for equilibrium values of $\ln Q$ up to 2 with no restrictions in the isotopic composition of the mixtures. These conditions take account of most of the experimental range that corresponds to the one stage units operating under total reflux. The obtained results support an empirical relation for the relaxation time proposed in a previous work. (auth)

Feed Materials Processing

Refer also to abstract 13892.

13836 (ORNL-TM-4903(Vol.1)) CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING "AS LOW AS PRACTICABLE" GUIDES: MILLING OF URANIUM ORES. Sears, M. B.; Blanco, R. E.; Dahlman, R. C.; Hill, G. S.; Ryon, A. D.; Witherspoon, J. P. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 291p. Dep. NTIS $7.60.

A cost-benefit study was made to determine the cost and effectiveness of radioactive waste (radwaste) treatment systems for decreasing the release of radioactive materials from model uranium ore processing mills, and to determine the radiological impact (dose commitment) of the released materials on the environment.

The study is designed to assist in defining the term "as low as practicable" in relation to limiting the release of radioactive materials from nuclear facilities. The base case model mills are representative of mills which will process a major fraction of the ore in the next 20 years. Each mill processes 2,000 short tons of ore per day. Additional radwaste treatment techniques are applied to the base case mill and the waste tailings area in a series of case studies to decrease the amounts of radioactive materials released and to reduce the radiological dose commitment to the population in the surrounding area. The cost for the added waste treatment operations and the corresponding dose commitment are calculated for each case. In the final analysis, radiological dose is plotted vs the annual cost for treatment of the radwastes. The status of the radwaste treatment methods used in the case studies is discussed. Much of the technology used in the advanced cases will require development and demonstration and is not suitable for immediate use. The methodology used in estimating the costs, detailed calculations, and tabulations is presented in ORNL-TM-4903, Volume 2. The methodology and assumptions for the radiological doses are found in ORNL-4992. (auth)

13837 (RL-SEP-274) Z PLANT FEED SPECIFICATIONS, PLUTONIUM NITRATE SOLUTIONS. Walser, R. L. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 10 Sep 1965. 23p. Dep. NTIS $4.25.

Declassified [1975].

This specification covers plutonium nitrate solutions received from Purex, Redox, and the Plutonium Reclamation Facility for use as feed for the present button line process (oxalate precipitation) to produce plutonium metal. More restrictive specifications may be required to enable production of high-purity intermediate products (PuO_2, PuF_4) to meet the requirements of special orders by various customers. Such specifications will be negotiated separately. The specification is designed to insure consistent production of buttons which will meet the rigid requirements of the customer. Impurity limits specified are based on decontamination factors determined in a recent study of the current process capability. All previous specifications concerning feed for the present button line are superseded by this document. (auth)

13838 PRECIPITATION OF PLUTONIUM DIOXIDE FROM CHLORIDE MELTS. Gorbunov, V. F.; Novoselov, G. P.; Ulanov, S. A. Sov. At. Energy (Engl. Transl.); 37: No. 5, 1202-1203 (Nov 1974).

Translated from At. Energ. (USSR); 37: No. 5, 435-436(Nov 1974).

The precipitation of plutonium dioxide from melts of LiF-NaF-PuF_4 with oxides of calcium and aluminium at 800°C was studied. In the presence of excess calcium oxide, the plutonium concentration is lowered to a value of $<5 \times 10^{-4}$% by weight which permits virtually complete isolation of plutonium from the melt. In the presence of aluminium oxide, the plutonium concentration is lowered to 1.2×10^{-2}% by weight and remains constant during subsequent addition of the oxide. (LK)

13839 EQUIPMENT FOR A CONTINUOUS ANALYSIS OF ORES, ESPECIALLY RADIOACTIVE ORES. Adamec, V. Czech Patent 151,211. 22 Feb 1973. 3p. (In Czech).

Equipment is described for a continuous analysis of ores, especially of radioactive ores, featuring a continuous recording of weight transported by the conveyor and a simultaneous recording of physical properties of the ore and the time of evaluation. The said equipment may also be applied in other branches where the physical values determining the properties of materials can be picked up. (INIS)

Radiation Chemistry

Refer also to abstracts 14432–14435, 14966, 14974, and 16333.

13840 (AED-CONF-74-465-017) THE RESISTANCE OF TRANSPARENT PLASTICS TO IONIZING RADIATION. Wuendrich, K. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1974. 7p. INIS.

From discussion meeting on radiation chemistry of the polymers; Garching/Muenchen, F. R. Germany (23 Oct 1974).

With abstract.

A number of transparent plastics based on PMMA, PC, PS, SAN, and AMMA were exposed to γ rays, both for short-term and for long-term exposure conditions. The changes in technologically important mechanical and optical properties of the plastics were then examined. The plastics, which are primarily subject to cross-linking reactions naturally retain their mechanical properties the longest. However, under the long-term conditions, atmospheric oxygen causes degradation and considerably reduces the radiation resistance. The resistance to changes in the optical properties caused by the formation of chromophoric systems is different from the resistance to mechanical changes caused by degradation and cross-linking reactions. A general reduction in the degree of spectral transmission occurs, usually more slowly under the long-term conditions. The satisfactory retention of both mechanical and optical properties is observed in only a few plastics. (GE)

13841 (AERE-M-2702) SUPPRESSION BY DISSOLVED HYDROGEN OF THE RADIOLYSIS OF WATER BY MIXED RADIATION FIELDS. Burns, W. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1975. 24p. Dep. NTIS (US Sales Only) $4.25. UK £1.00.

Information relevant to the suppression of water decomposition by hydrogen in tubes of boric acid solution proposed for reactivity control in SGHW reactor systems is reviewed and correlated. (LK)

13842 (BMFT-FB-K-75-02) RADIATION CHEMICAL ADDITION OF FORMAMIDE TO α-OLEFINS. Dederichs, B.; Saus, A.; Siebertz, H. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Mar 1975. 19p. (In German). INIS.

The radiation-initiated addition of formamide to n-octene-(1), n-decene-(1), and n-dedecene-(1) was investigated in a homogeneous (tert.-butanol as a solvent) and heterogeneous phase (without solvents) as a function of molar ratio of the reactants, temperature, reaction time and chain length of the olefins. With the optimal molar ratio of 37 : 1 (formamide : olefin) and at 20°C the maximum yields were 9% of alkane carbonic acid amides in the homogeneous phase and, under simultaneous stirring, 27% in the heterogeneous phase. Increasing the temperature to 80°C gave higher yields in alkane carbonic acid amides up to 34% (homogeneous phase) and 52% (in heterogeneous phase), respectively. Best results were obtained with n-decene-(1). In every case an induction period was observed. (auth)

13843 (BNL-tr-604) SPECIFIC CAPABILITIES OF RADIATION- AND LASER-INDUCED MODIFICATION OF SUBSTANCES. Gol'danskii, V. I. Translated by S. J. Amoretty from Int. J. Radiat. Phys. Chem.; 7: No. 2/3, 339-343(1975). 10p. Dep. NTIS $4.00.

Laser radiation of specific energy and intensity can have a strong effect on the concentration of excited molecular and hence on the dissociation rate of molecules or the rate of radiolysis. As an example the effect of laser radiation on the dissociation of some molecules exposed to ultraviolet radiation was studied. (MCG)

13844 (CEA-N-1746, pp 116-118) GAMMA RADIOLYSIS OF ADENINE IN AERATED AQUEOUS SOLUTIONS. Mariaggi, N. 1974. (In French).

In First semi-annual progress report 1974. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

Nine radiolysis products of adenine were identified using thin-layer chromatography coupled with spectrometry. The structures of those substances together with that of 8-hydroxyadenine show the existence of a mechanism involving the attack of C8 and the 4-5 double bond of the puric ring. (FR)

13845 (CNAEM-R-133) SELF-DECOMPOSITION OF VITAMIN B-12. Erkol, A. Y. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1974. 42p. Dep. NTIS (US Sales Only) $5.25.

The breakdown of tritium-labelled cyanocobalamin under the influence of its own radiation was studied with a view to comparing the yield and type of self-radiolysis products with those arising from externally applied gamma radiation. At the specific activities available, self-decomposition is very slow, and an experiment was devised to accelerate the process. In this, cyanocobalamin was dissolved in high-specific activity tritiated water, so that vitamin destruction was brought about by the tritium beta rays from the solvent, and not the solute. Ordinary unlabelled vitamin B12 could be used in this work, but in order to facilitate analytical measurements, gamma-emitting ^{58}Co was used to label the solute. (auth)

13846 (CNAEM-R-141) RADIATION EFFECT ON THE ADIABATIC COMPRESSIBILITY OF LUBRICATING LIQUIDS. Yazgan, E. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1975. 5p. Dep. NTIS (US Sales Only) $4.00.

Measurements of sound wave velocity and density in four γ-irradiated lubricating liquids in the temperature range of 20-30°C have been made. The experimental technique used to measure the sound velocity depends upon the measurement of the total phase shift of an ultrasonic wave through a known liquid path. From the

measured velocity and density values adiabatic compressibilities have been calculated. It has been found that the adiabatic compressibility of four lubricating liquids decreases linearly with increasing radiation dose. (auth)

13847 (FRNC-TH-538) RADIO-OXIDATION OF 4-ISOPROPYLPYRIDINE. Analysis of Reaction Products by Thin Layer Chromatography. Riba, M. L. (Toulouse-3 Univ., 31 (France)). 28 Nov 1974. 114p. (In French). Dep. NTIS (US Sales Only) $8.75.

Thesis.

Oxidation of 4-isopropylpyridine by molecular oxygen was studied in the liquid phase, under γ-ray irradiation. The reaction products, identified as 4-isopropylpyridine hydroperoxide and 4-dimethyl pyridyl carbinol, were quantitatively evaluated by thin-layer chromatography using in-situ photodensitometry. The experimental procedures used permitted the selective formation of an appreciable amount of hydroperoxide: a product that may have important practical applications. This study also pointed out the accelerating effect of ^{60}Co-emitted γ-rays on the mentioned oxidation reaction. (auth)

13848 (IRI-133-74-06) IONIZATION IN THE TRACK OF A HIGH-ENERGY ELECTRON IN HYDROCARBON LIQUIDS: STUDY OF POSITIVE AND NEGATIVE ION SCAVENGING USING NANOSECOND PULSE RADIOLYSIS. Zador, E.; Warman, J.; Hummel, A. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Jun 1974. 44p.

The lifetime distribution of the charged particles in the track of a high-energy electron in cyclohexane and isooctane has been considered. Results on the decay of biphenyl ions in solutions of biphenyl obtained by means of pulse radiolysis with nanosecond time resolution have been compared with lifetime distributions calculated from the concentration dependence of the steady state scavenging, using recently determined absolute rate constant for reaction of excess electrons and mobilities of the charged species. The discrepancy is relatively small for cyclohexane but large for isooctane. It is concluded that the scavengers considerably affect the initial spatial distribution of the charged species in the track. The kinetics of the reaction of the positive species in cyclohexane and isooctane with biphenyl, TMPD, and pyrene has been considered. It has been concluded that the mobile positive species in cyclohexane reacts with pyrene with a rate constant of 5×10^{11} $M^{-1}s^{-1}$, and has a lifetime of 50 ns. In isooctane no evidence for the existence of a mobile positive species has been obtained. (NL)

13849 (UCRL-76588) TEMPERATURE DEPENDENCE OF X-RAY-INDUCED PHOTOCONDUCTIVITY IN KAPTON AND TEFLON. Barlett, R. H.; Fulk, G. A.; Lee, R. S.; Weingart, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Jul 1975. 14p. Dep. NTIS $4.00.

The x-ray induced photoconductivity in Kapton (Dupont polyimide) and Teflon over the temperature range 100–500^{0}K was measured. The observed temperature dependence of the photoconductivity was strikingly different for the two materials. The qualitative behavior of the Kapton samples was consistent with the predictions of a model where the delayed photoconductivity signal is due to thermal release of trapped charge. With Teflon samples, the observed prompt conductivity was almost temperature independent, and a pronounced peak in the delayed component of the photoconductivity at about 360^{0}K was observed. Changes in the occupation of deep trapping levels is discussed as a possible mechanism for the observed thermal quenching of the Teflon photoconductivity. (LK)

13850 PRODUCTION OF URETHANE GROUP CONTAINING COATINGS BY CURING WITH IONIZING RADIATION. Spoor, H.; Demmler, K. (to Badische Anilin- and Soda-Fabrik Aktiengesellschaft). US Patent 3,871,908. 18 Mar 1975. Priority data 31 Dec 1970, F. R. Germany. 6p.

A process is described for the manufacture of coatings by applying ionizing radiation to a composition which contains olefinically unsaturated polymeric materials having urethane groups and which has been applied to a substrate. The polymeric materials may be used in combination with olefinically unsaturated monomeric compounds and conventional additives. (LK)

13851 SPECTRA AND DYNAMICS OF TRANSIENTS FORMED BY THE ACTION OF PULSE RADIOLYTICALLY GENERATED HYDRATED ELECTRONS AND HYDROXYL RADICALS ON ACRYLIC ACID DERIVATIVES. Madhavan, V. Boston, MA; Univ. of Boston Graduate School (1975). 255p. University Microfilms Order No. 75-12,256.

Thesis (Ph. D.).

The reactions of hydrated electrons, hydrogen atoms and hydroxyl radicals with acrylic acid and twelve other compounds derived from it have been studied in aqueous solution by means of the technique of pulse radiolysis-kinetic absorption spectrophotometry. Primary and secondary transient spectra produced in these reactions as well as their kinetic transformations have been characterized. From these, the nature of the chemical species formed, the reactions they undergo and the kinetics of these reactions have been inferred. (LK)

13852 THERMOLUMINESCENCE AND ISOTHERMAL DECAY OF LUMINESCENCE IN X-IRRADIATED UREA AND THIOUREA. Macciotta Serpi, P.; Rucci, A.; Serpi, A. (Univ., Cagliari, Italy). J. Lumin.; 96: No. 6, 488-501(Jan 1975).

Experiments were performed on thermoluminescence and the isothermal decay of luminescence of both urea and thiourea crystals excited by x-rays at low temperature. Analysis of the isothermal decay curves was performed assuming that the light emission consists of a sum of exponential decays with different time constants ω. Taking into account the dependence of ω from temperature, the values of thermal activation energies of the trapping centers involved in the luminescence process are obtained. The analysis of the glow curve, performed by three different methods, allowed the values of some parameters related to the thermoluminescence process, such as the thermal activation energy E, the frequency factor s, and the ratio A/B between the retrapping and recombination probabilities to be obtained. These results agree well enough with those from the isothermal decay analysis. Results for urea and for thiourea were compared. Some topics concerned with the nature of the defects responsible for the luminescence process in these substances are also investigated. (NL)

13853 DOSE DEPENDENCE OF γ-IRRADIATED LIQUID n-ALKANES FRAGMENTATION PRODUCTS. Avdonina, E. N. (Moscow State Univ.). Radiat. Eff.; 24: No. 4, 263-266(Mar 1975).

The data on the dose dependence of light hydrocarbon radiation yields observed in liquid n-pentane γ-radiolysis can be accounted for to a high degree, assuming that (a) unsaturated compounds, accumulating with dose, decrease light hydrocarbon yields in the same way as electron scavengers at very low doses; (b) low molecular weight olefins content decrease due to the attachment of thermal H atoms; the radicals produced give mainly respective alkanes, thus increasing fragment alkanes yields; (c) the reactions of short radicals with unsaturates do not appear significant. (auth)

13854 METAL SOLUTIONS IN AMINES AND ETHERS. Dye, J. L. (Michigan State Univ., East Lansing). pp 77-95 of Electrons in Fluids: The Nature of Metal–Ammonia Solutions. Jortner, J. (ed.). New York; Springer-Verlag (1973).

From 3rd Weyl conference; Tel Aviv, Israel (19 Jun 1972). See CONF-720681-.

Recent studies of metal solutions in amines and ethers are reviewed. The metal solubility can be greatly enhanced by the addition of "crown" and "cryptate" to the solution. Studies are also presented, which provide evidence for the existence of the monomer (M) and alkali anion (M^-) species. Finally a general equilibrium scheme for all species is presented and the influence of the solvent is discussed. (auth)

13855 EXTINCTION COEFFICIENTS OF SOLUTIONS OF ALKALI METALS IN AMINES. Nehari, S.; Bar-Eli, K. (Tel-Aviv Univ., Israel). pp 98-101 of Electrons in Fluids: The Nature of Metal–Ammonia Solutions. Jortner, J. (ed.). New York; Springer-Verlag (1973).

From 3rd Weyl conference; Tel Aviv, Israel (19 Jun 1972). See CONF-720681-.

The extinction coefficient of metal anion and solvated electron was measured in solutions of sodium and potassium in PDA and EDA. Measurements were carried out by (a) measuring the absorbancies and concentration of metal and using the equilibrium M^- in equilibrium $M^+ + 2e^-$; (b) measuring the rate of increase of the bands with electrical current. The extinction coefficients are: (M^-) equals 42,500 M^{-1} cm^{-1} and (e^-) equals 2100 M^- cm^{-1}. The equilibrium constant for the above reaction is calculated. (auth)

13856 QUASI-FREE ELECTRONS IN POLAR LIQUIDS. Delahay, P. (New York Univ., NY). pp 131-138 of Electrons in Fluids: The Nature of Metal–Ammonia Solutions. Jortner, J. (ed.). New York; Springer-Verlag (1973).

From 3rd Weyl conference; Tel Aviv, Israel (19 Jun 1972). See CONF-720681-.

Information on solvated and quasi-free electrons obtained from photoelectron emission (PEE) spectroscopy is discussed. Topics covered: production of quasi-free electrons in solution by optical transition; resolution of the absorption spectrum of solvated electrons in various solvents; rate of loss of kinetic energy of quasi-free electrons in solution from PEE spectra; energy distribution curve for electrons emitted by solutions in vacuum. (auth)

13857 RADIOLYTIC AND PHOTOLYTIC FORMATION OF STABLE e/sub am/$^-$ IN AMIDE SOLUTIONS. Belloni, J.; Saito, E. (Laboratoire de Physico-Chimie des Rayonnements, Orsay, France). pp 462-471 of Electrons in Fluids: The Nature of Metal–Ammonia Solutions. Jortner, J. (ed.). New York; Springer-Verlag (1973).

From 3rd Weyl conference; Tel Aviv, Israel (19 Jun 1972). See CONF-720681-.

The yields of formation of solvated electrons in the radiolysis of liquid ammonia obtained by varying the dose, the concentration of KNH_2 and the hydrogen pressure are interpreted on the basis of a competition between the ionization of the radical NH_2, giving NH^-, and its reaction with e$^-$/sub am/. This mechanism implies that the reactivity of NH_2 towards H_2 is much weaker than that of its ionized form, NH^-. One can then determine the ratio of the rate constants k/sub e$^-$ + NH_2)//k'/sub NH^- + NH_2)/ equals 1.5×10^5 and, from the limiting value of G(e$^-$/sub am/) at high amide concentrations, the primary radiolytic yield G/sub e$^-$ sub am/ equals 1.9. (auth)

13858 "SPIN OFF" OF SOLVATED ELECTRON RESEARCH. Schindewolf, U. (Univ., Karlsruhe, Ger.). pp 483-485 of Electrons in Fluids: The Nature of Metal–Ammonia Solutions. Jortner, J. (ed.). New York; Springer-Verlag (1973).

From 3rd Weyl conference; Tel Aviv, Israel (19 Jun 1972). See CONF-720681-.

Spin-off of solvated electron research in two applied fields is discussed: isotope separation and the destruction of a dangerous poison. The application of isotope separation can be used in heavy water production. The other application is in the destruction of cyanide wastes. (LK)

13859 RADIATION–CHEMICAL TRANSFORMATIONS OF As(III) AND As(V) IONS IN AQUEOUS SOLUTIONS. Nanobashvili, E. M.; Mamaladze, M. V. (Inst. of Inorganic Chemistry and Electronics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 78: No. 2, 353-356(May 1975). (In Russian).

The radiolysis of arsenites and arsenates in aqueous solutions in the presence of alcohols in various conditions has been studied. In the system 10^{-2} M H_3AsO_4–1M C_2H_5OH–H_2O, at pH = 2, As(v) ions are reduced to As^0, with the yield of $G(As^0) \simeq 1.9$. In the system 10^{-2} M Na_3AsO_3–1M C_2H_5OH–H_2O, at pH = 2.3, the separation of As^0 with the yield of $G(As^0) = 2.88 \pm 0.03$ was observed. (auth)

13860 STUDY OF THE RADICALS FORMED IN γ-IRRADIATED NAPHTHALENE, ANTHRACENE, AND PHENANTHRENE. Shanshiashvili, M. I.; Gaponova, I. S.; Zedelashvili, H. N.; Ershov, B. G. (Inst. of Physical and Organic Chemistry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 78: No. 2, 357-360(May 1975). (In Russian).

EPR spectral study has shown that in γ-irradiated naphthalene, anthracene and phenanthrene, cyclohexadiene radicals and ion- or phenol radicals of the given products are formed. (auth)

13861 ELECTRONS IN FLUIDS: THE NATURE OF METAL–AMMONIA SOLUTIONS. Proceedings of a Conference Held in Upper Galilee, Israel, June 19–23, 1972. Jortner, J.; Kestner, N. R. (eds.). New York; Springer-Verlag (1973). 505p. (CONF-720681-). $44.10.

From third Weyl conference; Tel Aviv, Israel (19 Jun 1972).

Thirty-eight papers were presented at the conference. Five were abstracted and indexed separately. One paper previously appeared in NSA as 29:18188. (LK)

For abstracts of individual papers see: 13854–13858.

13862 PREPARATION OF STANDARD MIXTURES OF IODOALKANES BY IRRADIATION OF IODINE SOLUTIONS IN ALKANES. Castello, G.; d'Amato, G. (Univ., Genoa). J. Chromatogr.; 108: No. 1, 194-200(May 1975).

13863 TEMPERATURE DEPENDENCE OF THE PHOSPHORESCENCE OF CaF^2:Mn OF PHOSPHOR IN DIFFERENT ATMOSPHERES. Chaung, L. S. (Chinese Univ. of Hong Kong). J. Lumin.; 9: No. 6, 483-487(Jan 1975).

The temperature dependence in the region of 24 to 150°C of the phosphorescence of CaF_2:Mn phosphor in the atmospheres of nitrogen gas, vacuum, and moisture-saturated air were studied. A decay formula was found to adequately describe the rate of decay of the trapped electrons, which is assumed to be proportional to the amount of phosphorescence observed, in thermal traps. In nitrogen gas and vacuum the decay constants of the trapped electrons are dependent only on the storage temperature and not on the storage atmosphere of the phosphor. A slight effect of water on the rate of decay of the trapped electrons was also observed. (NL)

13864 KINETICS OF COMPLEXATION OF COPPER(I) IONS WITH MALEATE AND FUMARATE IN AQUEOUS SOLUTIONS. A Pulse Radiolytic Study. Meyerstein, D. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). Inorg. Chem.; 14: No. 7, 1716-1717(Jul 1975).

Nitrous oxide saturated solutions containing 1.0×10^{-2}M $CuSO_4$, 1.0M methanol, and 1.0×10^{-5} to 1.0×10^{-3}M of fumaric or maleic acid at pH 3.65 were irradiated by 2.5×10^{19} eV/l pulse. All radicals formed under the experimental conditions reduce Cu/sub aq/$^{2+}$ to Cu/sub aq/$^+$. The absorption spectra of the products formed by the radiolysis were measured. The kinetics of formation of the absorption caused by the Cu(I) complex with fumaric or maleic acid obeyed a pseudo-first-order rate law. The reaction rates for the formation of the maleic and fumaric complexes were determined and the stability constants were calculated. (JSR)

13865 PULSE RADIOLYSIS STUDY OF IMIDAZOLE AND HISTIDINE IN WATER. Rao, P. S. (Army Natick Labs., MA); Simic, M.; Hayon, E. J. Phys. Chem.; 79: No. 13, 1260-1263 (19 Jun 1975).

The reaction rate constants of e/sub aq/$^-$ and OH radicals with imidazole (ImH), N-methylimidazole (MeIm), histidine, and N-methylhistidine were determined. The k(e/sub aq/$^-$ + S) values were strongly dependent on the state of protonation of the "pyridine" nitrogen in these molecules, with rates of approximately 5×10^9 M^{-1} sec^{-1} at pH approximately 6.0 and (approximately $1 - 2) \times 10^7$ M^{-1} sec^{-1} at pH approximately 10.0. The k(OH + S) values show only small but significant changes with pH with rates of approximately 5×10^9 M^{-1} sec^{-1} at pH 4 to 5 and approximately 9.0×10^9 M^{-1} sec^{-1} at pH 9 to 10. The transient absorption spectra of the e/sub aq/$^-$ and OH radical adducts to these molecules were observed. For e/sub aq/$^-$ addition to imidazole at pH approximately 5.0, the ImH_2· radical suggested to be formed has maxima at 300 and 360 nm and $epsilon_{300}$ 5.6×10^3 M^{-1} cm^{-1}; the MeImH· radical has maxima at 310 and 360 nm with $epsilon_{360}$ 6.1×10^3 M^{-1} cm^{-1}. The OH radical adducts to ImH_2^+ and ImH have maxima at 295 and 400 nm and at 310 and 390 nm, respectively. A pK/sub a/(radical) equals 6.1 is observed for the equilibrium OH· ImH_2^+ reversible OH· ImH + H^+, which is close to pK/sub a/ equals 7.1 for loss of a proton from the "pyridine" nitrogen of imidazole. The results from the OH radical adduct to N-methylimidazole support this assignment. Similar results were obtained for histidine and N-methylhistidine. The decay kinetics of the free-radical intermediates were determined. (auth)

13866 DISSOCIATION OF HYDROXYL PROTONS OF BETA-HYDROXYALKYL RADICALS AS STUDIED BY ELECTRON SPIN RESONANCE. Kirino, Y. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 79: No. 13, 1296-1300(19 Jun 1975).

The ESR spectra of seven beta-hydroxyalkyl radicals produced by OH addition to olefinic compounds have been examined in strong base by the in situ radiolysis method. Above pH 13 significant changes in ESR parameters, especially large changes in beta-proton coupling constants, are observed and can be interpreted in terms of the dissociation of the hydroxyl protons. The pK values of the radicals have been determined to be 14.6 for $^-O_2CCHCH_2OH$, 14.9 for $^-O_2CC(CH_3)CH_2OH$, 13.3 for $NCCHCH_2OH$, 14.7 for CH_2CH_2OH, 14.6 for CH_3CHCH_2OH, 15.1 for CH_3OCHCH_2OH, and 15.2 for $^-O_2CCHCH(CO_2^-)OH$. The pK values for the beta-hydroxyalkyl radicals derived from ethanol and propanol are, respectively, 1.2 and 1.5 units lower than for the parent alcohols. Limitations to the meaning of certain of the above values resulting from the applicability of the available acidity functions at very high base concentrations are discussed in detail. A correlation is obtained between pK values and Hammett sigma/sub p/ values for substituents on the trivalent carbon atom. In all radicals a decrease in the alpha-proton coupling constants and an accompanying slight increase in g factors are observed upon dissociation, indicating an increase in the amount of spin density on the oxygen atom in the dissociated form. (auth)

13867 DEPENDENCE OF THE THERMODYNAMIC STABILITY OF THE SOLVATED ELECTRON IN BINARY LIQUID SOLUTIONS ON THERMODYNAMIC SOLUTION STABILITY PRIOR TO ELECTRON INJECTION. Weinstein, J. B.; Firestone, R. F. (Ohio State Univ., Columbus). J. Phys. Chem.; 79: No. 13, 1322-1323 (19 Jun 1975).

Relationships between deviations from E/sub lambda max/, the photon energy at the wavelength of maximum absorption intensity, from the composition weighted average value and corresponding deviations of the enthalpy, entropy, and Gibbs free energy of mixing from those of an ideal solution were examined for all binary liquid solutions for which requisite data are available. No systematic correlations were found between the excess equimolar shift and the enthalpy or entropy of mixing at room temperature. (JSR)

13868 RADIATION IN CHEMICAL TECHNOLOGY. Rao, K. N. (Bhabha Atomic Research Centre, India). Nucl. India.; 13: No. 7, 1-3(Mar 1975).

Basic principles, suitable chemical processes, and radiation as a tool in chemical technology are discussed. Examples of wood-plastic polyacetal, grafting nylon and terylene, and synthetic detergent production are given. (MCG)

13869 CRYOPROTECTION OF IRRADIATED SPECIMENS. Box, H. C. pp 279-285 of Physical Aspects of Electron Microscopy and Microbeam Analysis. Siegel, B.; Beaman, D. R. (eds.). New York; John Wiley and Sons (1975).

Radiation chemistry at low temperature is discussed, including oxidation and reduction processes and secondary processes. The relevance of low-temperature radiation chemistry for electron microscopy is considered. (MCG)

13870 PULSE RADIOLYSIS OF AQUEOUS SOLIDS AT 76K. An Absorption Band in the Infrared. Buxton, G. V.; Gillis, H. A.; Klassen, N. V. (National Research Council of Canada, Ottawa, Ontario. Div. of Physics). Chem. Phys. Lett.; 32: No. 3, 533-536 (1 May 1975).

An ir absorption band with a maximum beyond 2400 nm was found and assigned to the electron in the following systems irradiated at 76°K: crystalline D_2O, and D_2O glasses of ethylene glycol, $MgCl_2$, and LiCl. The band is tentatively attributed to an electron captured in a D-defect. (auth)

13871 NOVEL RADIO-SETTING COATING COMPOSITIONS. Mileo, J. C.; Sillion, Bernard. (to Institut Francais du Petrole (IFP), 92 – Rueil-Malmaison; CEA, 75 – Paris (France)). French Patent 2,210,648/A/. 15 Dec 1972. 9p. (In French).

Novel setting coating compositions are described, in particular compositions capable of setting, or hardening, under an ionizing radiation. The compositions according to the invention are constituted by mixtures of chlorinated paraffins, of unsaturated resins of low molecular weight (more especially, unsaturated polyesters) and of at least one vinyl monomer. Such compositions can serve as varnishes or binding agents for paints or printing-inks. They can also be included in the composition of stratified materials or be used for manufacturing moulded articles. When hardening, in particular under the action of an electron-beam having a mean-power of from 100,000 to 75,000 electron volts, they give rise to articles with a fair surface hardening which in addition, are slightly flexible and fairly fire-proof. (FR)

13872 EMISSION AND ABSORPTION MOESSBAUER SPECTROSCOPY OF BENZYL TIN COMPOUNDS. Consequences of the Deexcitation of ^{119}Sn(met) and External Radiolysis. Mahieu, B.; Llabador, Y. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Lab. de Chimie Nucleaire). J. Phys. (Paris), Colloq.; No. 6, 329-333(1974). (In French).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The Moessbauer parameters of some tribenzyltin derivatives and their behavior on gamma irradiation were determined. It appears that an internal irradiation following the isomeric transition of ^{119}Sn(met) is far more efficient than an external irradiation by ^{60}Co. The shielding provided by the conjugated rings is however effective even through the aliphatic fragment which is bound to the central nucleus. The role played by oxygen during irradiation is also discussed. (FR)

13873 ELECTRON-SPIN RESONANCE AND THEORETICAL STUDIES OF RADICALS FORMED FROM TRIMETHYLAMINE BORANE: THE RADICALS Me_2N-BH_3 AND $(Me_3N-BH_3)^-$. Claxton, T. A.; Fieldhouse, S. A.; Overill, R. E.; Symons, M. C. R. (Leicester Univ., Eng.). Mol. Phys.; 29: No. 5, 1453-1459(May 1975).

Exposure of trimethylamine borane to ^{60}Co γ rays at 77°K gave, initially, a four-line ESR spectrum assigned to the radical anion, $Me_3\dot{N}$-BH_3^-, having a large (58 G) hyperfine coupling to boron. Theoretical calculations suggest that the radical resembles a perturbed $\cdot BH_3^-$ in which the normally planar unit still has considerable pyramidal character. After annealing above 77°K this species was lost and a multiline, isotropic spectrum grew in which, by comparison with spectra obtained from Me_3N-BD_3, is shown to belong to $Me_2\dot{N}$-BH_3 radicals. This species is of interest because of the large ^{1}H coupling to the -BH_3 protons (ca. 45 G). This coupling, qualitatively ascribed to hyperconjugation, is correctly reproduced by theoretical (ab initio UHF) calculations. (UK)

13874 ESR STUDIES OF $Cl_2^-(V_K)$ CENTRE TRAPPED IN IRRADIATED $Ca(ClO_3)_2 \cdot 2H_2O$ SINGLE CRYSTALS. Suryanarayana, D.; Sobhanadri, J. (Indian Inst. of Tech., Madras). Mol. Phys.; 29: No. 5, 1369-1376(May 1975).

A Cl_2^- center was trapped in x or γ-irradiated $Ca(ClO_3)_2 \cdot 2H_2O$ single crystals at 298°K, when the irradiated crystals were illuminated with ultraviolet light (360 nm). This center is formed at the expense of ClO_2 centers in this crystal. This Cl_2^- center is trapped at two magnetically inequivalent sites in the crystal lattice and these sites become equivalent when the static magnetic field is parallel or perpendicular to the b axis. At many orientations this center reveals "super-hyperfine" interaction with a proton ($I = \frac{1}{2}$) of the water of crystallization. The magnetic parameters are close to those observed in alkali chlorides and the ESR spectrum was fitted to an orthorhombic spin hamiltonian. The principal g values are $g_{xx} = 2.035$, $g_{yy} = 2.033$ and $g_{zz} = 2.000$ and those of the A values are $A_{xx} = 15.0$, $A_{yy} = 31.0$ and $A_{zz} = 109.0$ G. The shfs parameters are $A'_{||} = 5.0$ $A'_{\perp} = 1.0$ G. The V_K center trapped in this lattice is exceptionally stable at room temperature. (auth)

13875 ELECTRON SPIN ECHO ENVELOPE MODULATION OF TRAPPED RADICALS IN DISORDERED GLASSY SYSTEMS: APPLICATION TO THE MOLECULAR STRUCTURE AROUND EXCESS ELECTRONS IN γ-IRRADIATED 2-METHYLTETRAHYDROFURAN GLASS. Kevan, L.; Bowman, M.K.; Narayana, P.A.; Boeckman, R.K. (Department of Chemistry, Wayne State University, Detroit, Michigan 48202); Yudanov, V.F.; Tsvetkov, Yu.D. J. Chem. Phys. 63: No. 1, 409-416 (1 July 1975).

Three specifically deuterated 2-methyltetrahydrofurans (MTHF) have been synthesized to delineate the proton (deuteron) arrangement and hence the molecular arrangement around a trapped excess electron in γ-irradiated glassy MTHF at 77 K. The electron–deuteron anisotropic hyperfine interaction was detected by its modulation of the two-pulse electron spin echo envelope. Comparison of experimental and simulated modulation patterns shows that the excess electron is located about 3.7 Å below the center of the plane of the ring carbons in MTHF on the side opposite the methyl group and that three or four MTHF molecules constitute the first solvation shell. A second moment analysis of the EPR linewidths of the excess electron in the variously deuterated MTHF's independently supports the same structural conclusions. The shortest electron–proton distance is then ~3.1 Å, which compares moderately well with previous, less accurate ENDOR results. This structure seems somewhat more expanded than that indicated by theoretical calculations based on the semicontinuum model, but does not seem incompatible with that theoretical model. A small positive isotropic coupling to the ring protons (~1 MHz) is also indicated by the spin echo results. (auth)

13876 KINETICS OF THE RADIATION PROCESS OF $H_2 + Cl_2$ IN THE PRESENCE OF AIR AND WATER VAPOR. Dzhagatspanyan, R. V.; Kon'kov, N. G.; Lyaskin, Yu. G.; Orlova, N. E.; Panin, Yu. A.; Resnichenko, I. Z.; Upadyshev, L. B. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 25-33(1975). (In Russian).

The literature on the kinetics of the process is reviewed. The radiation experiments in the presence of air and steam shows that HCl synthesis goes together with radiolysis of steam and the formation of H_2 and contrary to photochemical process the radiation process proceeds in these conditions with bimolecular termination. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 15876.

Hot-Atom Chemistry

Refer also to abstract 13872.

13877 HYDROGEN ABSTRACTION BY FLUORINE ATOMS UNDER CONDITIONS OF THERMAL INITIATION: HYDROCARBONS AND FLUORINATED HYDROCARBONS. Manning, R. G.; Grant, E. R.; Merrill, J. C.; Parks, N. J.; Root, J. W. (Univ. of California, Davis). Int. J. Chem. Kinet.; 7: No. 1, 39-44(Jan 1975).

Modified nuclear recoil techniques have been used to obtain accurate relative bimolecular rate coefficients for thermally induced hydrogen abstraction reactions by atomic fluorine. New results are reported for 12 hydrocarbons and partially fluorinated hydrocarbons studied at 303°K. (auth)

13878 PRESSURE EFFECTS IN HOT ATOM CHEMISTRY. Winter, G. K. (Memorial Univ. of Newfoundland, St. John's (Canada). Dept. of Chemistry); Urch, D. S. (Queen Mary Coll., London (UK). Dept. of Chemistry). Chem. Phys. Lett.; 32: No. 3, 527-528(1 May 1975).

It is shown that the yield of $^3H \cdot H$, formed by the reaction of recoil tritium, with a hydrocarbon, is enhanced by low hydrocarbon pressures (<10 cm/Hg). (auth)

Properties of Radioactive Materials

Refer also to abstracts 13801, 14665, 14693, 14761, 14914, and 16302.

13879 (AECL-4917) STUDY OF THE HYDROLYSIS OF URANIUM MONOCARBIDE. Part I. Reactions in Steam in the Temperature Range 150°C to 2500°C. Dyck, R. W.; Taylor, R.; Boase, D. G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Mar 1975. 54p. Dep. NTIS (US Sales Only) $5.75. AECL $1.50.

Knowledge of the hydrolysis of uranium monocarbide in water and steam is needed to facilitate assessment of the probable effects of a loss-of-coolant accident in existing and proposed uranium carbide fueled, organic cooled reactors. High-purity uranium carbide in powdered and bulk form was exposed to steam at atmospheric pressure at temperatures between 150°C and the melting point, 2500°C. The reactions observed are described and compared with those predicted from thermodynamic data. The rates of hydrolysis, determined from the rate of evolution of the gaseous products, decrease with increasing temperature in the range 150°C to 400°C. At 150°C the rate is apparently determined by the basic chemical reactivity of uranium carbide and steam and probably involves the initial formation of hydroxyl ions and atomic hydrogen at the outer sample surface. At 400°C an adherent layer of uranium dioxide is formed on the carbide surface and the reaction rate is determined by diffusion of steam through this layer. Above 400°C the hydrolysis rate increases but does not exceed the 150°C rate until ~1000°C is attained. In comparison, uranium carbide fuel specimens irradiated to 81 MWh/kg and 400 MWh/kg are almost inert in steam at less than 400°C. At higher temperatures the hydrolysis rates are comparable to those of unirradiated material. The highest reaction rates were observed for powdered specimens and specimens of uranium carbide which had been stored in moist air. The behavior of uranium carbide fuel during a loss-of-coolant accident will be dependent upon its initial surface condition and temperature, its degree of subdivision, and burnup. Fresh fuel will hydrolyze most rapidly in low-temperature steam and water, while irradiated fuel will be most reactive above 700°C. (auth)

13880 (AECL-4918) STUDY OF THE HYDROLYSIS OF URANIUM MONOCARBIDE. Part II. Reactions in Water Between 25°C and 99°C. Dyck, R. W.; Boase, D. G.; Taylor, R.; Gerwing, A. F. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Apr 1975. 33p. Dep. NTIS (US Sales Only) $4.75. AECL $1.00.

The hydrolysis of uranium carbide was studied to provide information necessary for the assessment of the probable effects of a loss-of-coolant accident in an organic-cooled reactor. High purity hyperstoichiometric uranium monocarbide (5.12% C) when reacted with water yielded UO_2 and a gas (90.6 ml/g of UC) composed of 82 vol % methane, 11 vol % hydrogen, 4.5 vol % ethane and higher hydrocarbons. The yield and composition of the gases were independent of reaction temperature between 25°C and 99°C. For unirradiated carbide containing <100 μg/g oxygen as an impurity, the hydrolysis rates increased with temperature with an apparent activation energy of 14.4 kcal/mol (60.3 kJ/mol). With specimens containing bulk oxygen concentrations of 2000 μg/g, as the result of storage in moist air, a higher activation energy was obtained (30 kcal/mol (126 kJ/mol)) at the lower temperatures. Above 60°C, this material hydrolyzed much more rapidly than the higher purity specimens, indicating that oxygen when incorporated in the bulk of the material and on the surfaces, plays a dual role in the hydrolysis kinetics; decreasing the corrosion rate at low temperatures and enhancing it at the higher temperatures. The reactivity of irradiated uranium carbide in water was much lower than that of unirradiated material and the amount of hydrogen evolved increased with increasing fuel burnup. At a burnup of 400 MWh/kg, irradiated fuel specimens were essentially inert in water between 25°C and 60°C. The reasons for this are discussed briefly together with the effects of uranium carbide stoichiometry. The reactivity of unirradiated uranium carbide, and of carbide irradiated to approximately 100 MWh/kg, is higher in water at 99°C than in steam at 300-100°C, and processes which involve the cooling of hot fuel by the application of water must take this into account. (auth)

13881 (CEA-R-4668) SYNTHESIS AND STUDIES OF SOME ORGANOMETALLIC COMPOUNDS OF URANIUM IV. Marquet-Ellis, H.; Folcher, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Chimie). Jun 1975. 27p. (In French). Dep. NTIS (US Sales Only) $4.50.

The organometallic compounds of uranium IV have been well known for a long time but some difficulties in the syntheses exist. We describe the different steps of the procedures and the apparatus which allow these compounds to be obtained with good yields. The cyclopentadienyl compounds $U(C_5H_5)_3Cl$, $U(C_5H_5)_4$ are prepared by reaction of UCl_4 with $Na(C_5H_5)$ in tetrahydrofuran. The cyclooctatetraene compound $U(C_8H_8)_2$ "Uranocene" is obtained by reaction of $K_2(C_8H_8)$ on UCl_4 in tetrahydrofuran. The NMR spectrum of the solution during the reaction shows the appearance of the product. These compounds have been identified by chemical analysis and x rays. The visible spectra of $U(C_5H_5)_3Cl$ and $U(C_8H_8)_2$ in gaseous phase have been obtained. (auth)

13882 (HW-77591) SCREENING TESTS FOR PROPOSED MOLTEN SALT ELECTROLYTES. Becker, C. R.; Soine, T. S. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 10 May 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $4.00.

Declassified 5 Apr 1974.

An important function of the electrolyte used in the electrowinning of plutonium is to assist in the dissolution of unchlorinated plutonium oxide in the plutonium chloride feed. Since there are a great many inorganic salts and combinations of salts that could be used, a simple test was devised to screen the proposed salts and determine those with the most desirable characteristics. The purpose of this report is to compare the dissolution of PuO_2 in several salts using chlorine or hydrogen chloride sparge gases. Chlorine is part of the electrowinning environment and HCl could be admitted if found desirable. Another area where the electrolyte may play an important part is in product consolidation. Several salts were characterized in this respect by comparing their ability to consolidate subdivided metal obtained from the electrowinning runs. (auth)

13883 (KY-662) REMOVAL OF TRACE QUANTITIES OF NEPTUNIUM AND PLUTONIUM FLUORIDES FROM URANIUM HEXAFLUORIDE. Pulley, H.; Harris, R. L. (Paducah Gaseous Diffusion Plant, Ky. (USA)). 15 May 1975. Contract W-7405-eng-26. 49p. Dep. NTIS $4.00.

A fixed bed oxidation-reduction system was developed to remove parts per million quantities of neptunium and plutonium hexafluorides from uranium hexafluoride. The process, which has been demonstrated on a laboratory scale, utilizes selective reduction of neptunium and plutonium hexafluorides on a bed of cobaltous fluoride pellets and allows the uranium hexafluoride to pass through the trap unchanged. If desired, regeneration of a loaded trap may be accomplished by fluorination of the pellets to recover the transuranic elements as hexafluorides followed by hydrogen reduction to again form cobaltous fluoride. In conjunction with the trapping process, a sampling procedure was developed which is adequate for field sampling uranium hexafluoride cylinders for that portion of the transuranic hexafluorides that could be volatilized from the cylinder. (auth)

13884 (NP-20456, pp vp Paper 2) RADIOACTIVITY IN PLUTONIUM, AMERICIUM, AND CURIUM IN NUCLEAR REACTOR FUEL. Pigford, T. H. (Univ. of California, Berkeley). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The following topics are discussed: formation of plutonium, americium, and curium; radioactive decay properties; production and utilization of plutonium in nuclear power plants; uranium-fueled light-water reactor; light-water reactor fueled with natural uranium and recycle plutonium; and uranium-fueled fast breeder reactor. (HLW)

13885 (RFP-2382) REACTION GAMMA RAYS IN PLUTONIUM COMPOUNDS, MIXTURES, AND ALLOYS. Martin, H. R. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 16 Jun 1975. Contract AT(29-1)-1106. 18p. Dep. NTIS $4.00.

Gamma-ray spectra for 15 light elements, from lithium (Z equals 3) to potassium (Z equals 19), in plutonium compounds, mixtures, and alloys were obtained with germanium (lithium) detectors. Reaction gamma rays produced by plutonium alpha particle bombardment of light elements were identified and characterized by energy and production mode in the spectra. Neutron emission rates, relative to a plutonium dioxide standard, are also reported for several mixtures involving plutonium dioxide and light elements. (auth)

13886 (UCID-15644-74-4) GENERAL CHEMISTRY DIVISION QUARTERLY REPORT: OCTOBER-DECEMBER 1974. Harrar, J. E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Mar 1975. Contract W-7405-Eng-48. 117p. Dep. NTIS $9.00.

The status of various research projects in the Analytical Chemistry Division of the Lawrence Livermore Laboratory is reported, including fabrication and testing of certified subassemblies for the tritium analyzer, emission spectra of Cm, Bk, and Cf by Fourier transform spectroscopy; feasibility of using UI_4 as a uranium-atom source; vaporization of $U(thd)_4$; atomic-beam source for crossed-beam experiments with uranium; determination of halides by potentiometric titration with silver perchlorate; and characterization of surface properties of thorium. (LK)

13887 RADIOACTIVE XENON SOLUTION. (to General Electric Co.). Netherlands Patent 7,309,758/A/. 12 Jul 1973. 11p. (In Dutch).

An aqueous solution, having dissolved therein an isotopic mixture comprising natural xenon and a radioactive isotope of xenon is presented. The solution is prepared by dissolution of radioactive xenon gas in an aqueous solution already containing natural xenon. The specific activity of the solution does not decrease considerably upon repeated use. (NL)

13888 GEL CHROMATOGRAPHY COLUMN SCANNING FOR THE ANALYSIS OF ^{99m}Tc-LABELLED COMPOUNDS. Persson, B. R. R.; Darte, L. (Univ. of Lund, Sweden). J. Chromatogr.; 101: No. 2, 315-326(18 Dec 1974).

The gel chromatography column scanning (GCS) method has been studied, special attention being paid to its suitability for the analysis of ^{99m}Tc-labelled compounds and radiopharmaceuticals. The sample to be analyzed was applied at the top of a column filled with Sephadex G gel. Elution was carried out with 0.9% sodium chloride solution with such a volume that all the radioactivity was retained in the column. The column was then sealed and scanned with a 1 mm slit-collimated NaI(Tl) crystal. The GSC method is discussed and different factors influencing the scanning profile are considered. The relationship between the position of the activity peak in the scanning profile and the molecular weight of the sample is given for Sephadex G-25 Medium gel. (NL)

13889 SIMPLE AND INEXPENSIVE METHOD FOR THE PREPARATION OF [β,γ-^{32}P]GUANOSINE 5'-TRIPHOSPHATE. Warner, A. H. (Windsor Univ., Ont.). Biochim. Biophys. Acta; 383: No. 3, 229-235(21 Mar 1975).

A rapid and inexpensive method has been developed for the synthesis of ^{32}P-labelled guanosine 5'-triphosphate (GTP). When yolk platelets isolated from brine shrimp cysts are incubated with $^{32}PP_i$ at pH 5.8 and in the presence of 10 mM $MgCl_2$ and 5 mM dithiothreitol, the primary compound (β,γ-^{32}P) GTP formed. The synthetic reaction is catalyzed by the yolk platelet enzyme, GTP: GTP guanylyltransferase, which has been demonstrated to be important in the biosynthesis of diguanosine 5'-tetraphosphate (Gp_4G), the major purine nucleotide in brine shrimp yolk platelets and encysted embryos. (NL)

13890 HOW THE PLUTONIUM IS OBTAINED. Ramaniah, M. V.; Natarajan, P. R. (Bhabha Atomic Research Centre, Bombay). Sci. Today (Bombay).; 9: No. 3, 17-22(Sep 1974).

A brief account is given of the important physical, chemical and nuclear properties of plutonium. The oxidation states of plutonium and their absorption spectra are shown. Solvent extraction and ion exchange processes involved in the recovery of valuable plutonium from spent fuel (uranium) rods are described. PuO_2 obtained after recovery is used as fuel in fast reactors. Safety features to be provided in the design of a plutonium laboratory are discussed. Methods for estimation of plutonium in solutions are indicated. Other uses of plutonium as a radiation source, heating unit and as cardiac pacemaker, etc. are mentioned. (INIS)

13891 RADIO GAS CHROMATOGRAPHY OF CARBON-14-LABELLED COMPOUNDS USING CONTINUOUS ACTIVITY ASSAY BY A SEMICONDUCTOR DETECTOR. Tykva, R.; Seda, J. (Czechloslovak Academy of Sciences, Prague). J. Chromatogr.; 108: No. 1, 37-41(Mar 1975).

A method and apparatus are described for the direct measurement of ^{14}C activity in fractions leaving a gas chromatograph by means of a silicon-diffused detector; the simple device can readily be attached to a conventional chromatograph. The method was tested on substances boiling between 31.5° and 205.8°. With the use of a preparative gas chromatograph, with thermal-conductivity mass detection, the limit of detection of the device described was 0.15 μCi. (NL)

13892 NUCLEAR FUEL CYCLE. U. S. Capital and Capacity Requirements 1975–1985. New York; Atomic Industrial Forum, Inc. (1975). 61p. $20.00.

This Forum study reviews the nuclear fuel cycle in order to give Forum members a perspective of the U. S. industry's capability to support the Presidential program for 200 additional nuclear power plants within the next ten years. Three additional projected nuclear growth rates, one larger and two smaller than the Presidential program, are also examined for nuclear fuel cycle support needs. Uranium mining and milling, UF_6 production, uranium enrichment, fuel fabrication, spent fuel reprocessing, transportation, radioactive wastes, and capital requirements are considered. (LK)

13893 GAS COMPLEXES WITH $AlCl_3$, AlI_3, OR ($FeCl_3$), THEIR ABUNDANCE AND STABILITY. Schaefer, H. (Univ., Muenster, Ger.). Z. Anorg. Allg. Chem.; 414: No. 2, 151-159 (May 1975). (In German).

Gas complexes $MCl_m \cdot xAlCl_3$ ($FeCl_3$) cover a large area of the periodic table. The thermodynamic discussion shows the great stability of these complexes below 1200°K. The $\Delta H°$-values for the stepwise complex formation $MCl_2/MAlCl_5/MAl_2Cl_8$ are discussed. The important factor is the supplement of the coordination sphere. (auth)

13894 PARTITION OF FORMIC ACID, U(VI) AND Pu(IV) IN THE SYSTEM TBP–DODECANE–HNO_3–HCOOH–H_2O. Arsene, A. (Institut de Technologies Nucleaires, Bucharest); Germain, M. Rev. Roum. Chim.; 20: No. 2, 251-258(1975). (In French).

The principal results obtained in the study of the chemical processing of irradiated fuel elements are reported. The partition values are given graphically and in tabular form. The results indicate that Pu and U can be re-extracted from the TBP–HNO_3–HCOOH system with a suitable selection of the reagent concentrations. (JSR)

13895 ENHANCEMENT OF DATA DERIVED FROM A THIN-LAYER CHROMATOGRAPHY RADIOACTIVITY SCANNER BY ACCUMULATION AND FOURIER TRANSFORMATION. Wedzicha, B. L. (Ministry of Agriculture, Fisheries and Food, Norwich, Eng.). J. Chromatogr.; 101: No. 1, 79-82(4 Dec 1974).

A method of enhancing data, derived from the ratemeter of a thin-layer chromatography radioactivity scanner, for low levels of activity, is described. The averaging of data from several "rapid" scans followed by a smoothing operation involving Fourier transform results in an improvement of signal-to-noise ratio and resolution when compared with a single scan of the same total duration and using the smoothing components incorporated in the ratemeter. (NL)

13896 APPARATUS FOR AND APPLICATIONS OF DIFFERENTIAL THERMAL GAS ANALYSIS. Mizutani, N.; Kato, M. (Tokyo Inst. of Tech., Ookayama, Japan). Anal. Chem.; 47: No. 8, 1389-1392(Jul 1975).

A new apparatus for studying solid-state reactions and physicochemical heat changes involving absorption or evolution of gases has been developed. A sample is heated or cooled at constant rate in a flow of two or more different mixed gases such as He–O_2, Ar–H_2, etc. The changes in the composition of the gas passing through a reactor are detected by a thermal conductivity detector with high sensitivity. It is applicable to the range from room temperature to 1600°C and a gas flow of any mixing ratio (1 : 200–200 : 1). The new technique is as useful as DTA and TG in the fields of physical chemistry, inorganic chemistry, organic chemistry, metallurgy, etc. Applications to a few solid-state reactions (oxidation and reduction of cobalt oxides and formation and decomposition of $CaCo_3$ and UH_3) are discussed. (auth)

13897 EVALUATION OF TECHNIQUES FOR LABELLING THE SURFACE PROTEINS OF CULTURED MAMMALIAN CELLS. Juliano, R. L. (Univ. of Toronto, Ont.); Behar-Bannelier, M. Biochim. Biophys. Acta; 375: No. 2, 249-267(28 Jan 1975).

Four techniques are used for labelling the surface proteins of cultured mammalian cells (Chinese hamster ovary cells and mouse neuroblastoma cells), viz.: (a) lactoperoxidase catalyzed iodination with ^{125}I; (b) pyridoxal phosphate ^{3}H-borohydride system; (c) ^{3}H-4,4'-diisothiocyano-2,2'dihydrostilbene disulfonate system; and (d) galactose oxidase-^{3}H-borohydride system. The subcellular radioactive label distribution produced by these techniques was evaluated by autoradiography and by cellular fractionation. Cells were examined both in monolayers and in suspension. While all four systems label the surface membrane in the majority of the cell population, they also heavily label internal sites in a small subpopulation of nonviable cells. (NL)

13898 CHEMISTRY OF TECHNETIUM IN LOW OXIDATION STATES. Armstrong, R. A. Stanford, CA; Univ. of Stanford (1975). 149p. University Microfilms Order No. 75-13,480.

Thesis (Ph. D.).

Attempts to make technetium complexes in low oxidation states with only saturated ligands by the reduction of TcO_4^- and $TcCl_6^{2-}$ with reducing agents such as europous ion in aqueous solution failed to produce stable species. Technetium, in oxidation states one and two is stabilized by nitrosyl and hydroxylamine reacts with Tc(IV) to give technetium nitrosyls. Addition of ammonia results in t-$[(NH_3)_4Tc(NO)(OH_2)]Cl_2$. The compound is air stable, the ligands are inert to substitution, and the nitrosyl is inert to reducing agents. The pKa of the compound is 7.3. The complex t-$[(NH_3)_4$-$Tc(NO)(OH_2)]^{2+}$ can be oxidized (the Tc(II)-Tc(I) nitrosyl formal potential is 0.80 volts) by Ce(IV) to give t-$[(NH_3)_4Tc(NO)(OH_2)]^{3+}$. This complex was isolated as a chloride and is well characterized. The N–O stretch is at 1830 cm^{-1}. The affinity of Tc(I) nitrosyl for saturated ligands other than ammonia is low. Ethylenediamine and EDTA combine only to a limited extent and no characterizable complexes could be isolated. Tc(II) and even Tc(I) are apparently completely stabilized by NO^+ because the affinity for additional

unsaturated ligands is not great. Nitrosyl appears to be a special case in stabilizing technetium. A dinitrogen complex of technetium, analogous to the nitrosyl, could not be made and unsaturated ligands such as isonicotinamide and pyridine appear to form stable complexes only with Tc(IV). Reduced forms of Tc with these ligands were shown to exist by cyclic voltammetry, but could not be isolated using chemical techniques. (Diss. Abstr. Int., B)

13899 PHOTOELECTRON SPECTRA OF URANIUM (V) IN MIXED OXIDES SHOWING CHARACTERISTIC SATELLITE SIGNALS. Keller, C. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie); Joergensen, C. K. (Geneva Univ. (Switzerland)). Chem. Phys. Lett.; 32: No. 3, 397-400 (1 May 1975).

Whereas uranyl compounds at most show electron transfer satellites at 3 eV higher I in the U4f region, mixed oxides containing uranium (V) show a characteristic satellite at 7.9 eV higher I. Uranium-cerium blue and certain U-(IV) compounds are also discussed. (auth)

13900 BISULFITE-CATALYZED TRITIUM LABELING OF DNA AND RNA. Iida, S.; Wataya, Y.; Kudo, I.; Kai, K.; Hayatsu, H. (Univ. of Tokyo). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 39: 263-266(1 Mar 1974).

The results of the ammonium bisulfite-catalyzed tritium labeling of DNA and RNA are reported. Bisulfite catalyzes the $H \rightarrow {}^{3}H({}^{3}H)$ exchange at position 5 of pyrimidine nucleotides CMP and UMP. In previous methods, the 8 positions of purines were the sites of the exchange. In contrast to the easy back exchange $({}^{3}H \rightarrow H)$ of 8-$({}^{3}H)$ purines in H_2O, the 5-$({}^{3}H)$ pyrimidines do not lose the isotope under usual reaction conditions. (ERB)

Radioactive Waste Treatment

Refer also to abstracts 13836, 15022, 15024–15026, 15028, 15029, 16199, 16200, and 16580.

13901 (BARC-765) SELECTION OF SUITABLE ACTIVATED CHARCOAL FOR IODINE FILTERS. Deshingkar, S. S.; Ramarathinam, K.; Khan, A. A. (Bhabha Atomic Research Centre, Bombay (India). Desalination and Effluent Engineering Div.). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

Because of its high volatility and low maximum permissible concentration in air, radioiodine must be removed from exhausts of iodine isotope processing plants, hospitals using ^{131}I and other nuclear facilities. With a view to developing iodine filters in India, four different activated charcoals were evaluated under ambient conditions for their iodine removal efficiencies at different iodine concentrations, temperatures, relative humidities and contact times. One indigenous charcoal was found to be suitable for the use in iodine filters. (auth)

13902 (BNWL-B-419) PLUTONIUM RECOVERY FROM INCINERATOR ASH AND CENTRIFUGE SLUDGE BY PEROXIDE FUSION. Partridge, J. A.; Wheelwright, E. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-1830. 16p. Dep. NTIS $4.00.

A technique was demonstrated for solubilizing the plutonium contained in incinerator ash and in other waste solids (such as solids accumulated by centrifugation after solvent extraction contacts in the plutonium reclamation facility at Hanford). A sodium hydroxide–sodium peroxide fusion is performed on the Pu-containing solids. The cooled melt is then dissolved in dilute nitric acid. Mild steel cans were used as "single use" crucibles for the fusions. Both the can and the cooled melt are dissolved in nitric acid. Fusion tests were conducted on three different cans of incinerator ash and on one can of centrifuge sludge. The series of tests demonstrated that a caustic-peroxide fusion treatment can yield 95 percent or greater recovery of plutonium from these waste solids. In most cases, quantitative recovery of the plutonium can probably be achieved by recycling the residual solids obtained in aqueous dissolution of the cooled fusion mixture. Tests with some of the incinerator ash and with the centrifuge sludge resulted in gelatinous precipitates which were difficult to separate from the nitric acid dissolver solution. These gelatinous precipitates present what is probably the major problem to be overcome in the use of this Pu recovery method. Techniques need to be examined for making these residual solids less difficult to separate from the dissolver solution. (auth)

13903 (DP-1373) EVALUATION OF METHODS FOR RETENTION OF RADIOIODINE DURING PROCESSING OF IRRADIATED ^{237}Np. Thompson, G. H.; Kelley, J. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jun 1975. Contract AT(07-2)-1. 32p. Dep. NTIS $4.00.

Methods of removing radioiodine from ^{237}Np–^{238}Pu dissolver solution and process off-gas were investigated. This program is part of a continuing effort to reduce releases of radionuclides from plant operations. Experimental data show: Greater than 99.9 percent of the radioiodine in dissolver solution can be removed by precipitation, in situ, of manganese dioxide. Silver zeolite will sorb greater than 99.9 percent of radioiodine in process off-gas. Other solid sorbents and nitric acid-mercuric nitrate scrubber solutions do not remove appreciable amounts of radioiodine from process off-gas, because radioiodine is present principally as relatively unreactive organic iodine compounds. (auth)

13904 (HEDL-TME-75-5) ACID DIGESTION OF COMBUSTIBLE WASTES: A STATUS REPORT. Lerch, R. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. 84p. Dep. NTIS $5.45.

Work at the Hanford Engineering Development Laboratory on development of the acid digestion process for treating combustible wastes is discussed. Materials such as paper, rubber, and plastics are readily decomposed into a low volume, noncombustible residue. Engineering results using the Acid Digestion Test Unit are discussed. Tests to date generally duplicated earlier laboratory results with respect to waste processing rates, volume reduction, off-gas generation rates and volumes, acid consumption, and completeness of reaction. Demonstrated processing rates were as high as 5 kg/hr for short duration run periods. The tests indicated engineering feasibility of the acid digestion process and showed acid digestion to be a potentially attractive method for treating combustible nuclear wastes. Other areas discussed in the report are behavior of plutonium and americium during acid digestion, behavior of various construction materials, and safety. An integrated flowsheet for operation of an acid digestion unit is also presented. (auth)

13905 (INIS-mf-1639(Vol.1), pp 12-24) MAIN DIRECTIONS OF INVESTIGATIONS INTO RADIOACTIVE WASTE DECONTAMINATION. Minchevski, E. (Inst. of Nuclear Research, Warsaw). 1973. (In Russian).

From proceedings of a scientific and technical conference; Colobjeg, Poland (2 Oct 1972).

In investigation into liquid, solid and gaseous radioactive waste processing and surface decontamination.

The chief objectives of studies on decontamination of radioactive wastes are considered briefly. The chief sources and classifications of radioactive wastes; the radioactive wastes obtained in the production and use of radioisotopes; radioactive wastes in plants for ore and nuclear fuel manufacture and from nuclear power stations; and wastes obtained in processing of nuclear fuel are discussed. Methods for burial of radioactive wastes are considered. (INIS)

13906 (INIS-mf-1639(Vol.1), pp 27-37) ECONOMICAL PROBLEMS OF RADIOACTIVE WASTES DECONTAMINATION AND DISPOSAL. Bukina, I. G.; Sedov, V. M.; Rybal'chenko, I. L.; Permyakov, A. A.; Yakushev, M. F. (State Committee on Utilization of Atomic Energy, Moscow). 1973. (In Russian).

From proceedings of a scientific and technical conference; Colobjeg, Poland (2 Oct 1972).

In investigation into liquid, solid and gaseous radioactive waste processing and surface decontamination.

Calculations of various authors have verified the basic assumptions of the relation between the cost of processing wastes and their specific radioactivity, the chemical composition, and the capacity of the equipment. Two- or three-stage equipment of the type used at the Moscow and Leningrad purification plants, despite the known complexity, will have universal application and will ensure the required purity over a wide range of chemical and radiochemical compositions of the original water. This equipment at maximum load has relatively low specific technico-economic indexes. Solidification of liquid concentrates by using cement or bitumen will decrease the overall expenses in use. (INIS)

13907 (INIS-mf-1639(Vol.1), pp 53-59) DRAFT PROJECT OF RADIOACTIVE WASTES PROCESSING AT THE FIRST POLAND NUCLEAR POWER PLANT. Kshistynayak, E.; Lashkevich, E.; Tsyran, M. (Biuro Studiow i Projektow Energoprojekt, Warsaw). 1973. (In Russian).

From proceedings of a scientific and technical conference; Colobjeg, Poland (2 Oct 1972).

In investigation into liquid, solid and gaseous radioactive waste processing and surface decontamination.

Changes in the scheme used in Blocks III and I of the Novo-Voronezh electrical power station are considered. The processing of liquid radioactive wastes including the heat transfer agent of the first loop and the trap and deactivation waters, of radioactive gases, and of radioactive solid wastes is described. (INIS)

13908 (KFK-2104) INCORPORATION OF RADIOACTIVE WASTES INTO BITUMEN. Part I. The Bituminization Plant for Radioactive Evaporator Concentrates at the Karlsruhe Nuclear

Research Center. Meier, G.; Baehr, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Behandlung Radioaktiver Abfaelle). Apr 1975. 33p. (In German). Dep. NTIS (US Sales Only) $4.75.

Experience obtained during the first three years operation of the industrial bituminization plant is summarized. At the beginning of 1972 a plant for the incorporation of radioactive evaporator concentrates into bitumen started operation in the Karlsruhe Nuclear Research Center. This plant allows the production of solidified waste that is suitable for disposal in the salt mine Asse. Products of ≤ 0.5 wt% residual H_2O and up to 60 wt% salts can be obtained. A detailed description of the plant and its components is given. The experience of the cold test runs and the resulting modifications are reported together with the experience of more than two years hot operation. Decontamination factors and product properties are given. Two incidents that happened during hot operation are reported. (auth)

13909 (ORNL-TM-4902) CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING "AS LOW AS PRACTICABLE" GUIDES: FABRICATION OF LIGHT-WATER REACTOR FUEL FROM ENRICHED URANIUM DIOXIDE. Pechin, W. H.; Blanco, R. E.; Dahlman, R. C.; Finney, B. C.; Lindauer, R. B.; Witherspoon, J. P. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 220p. Dep. NTIS $7.60.

A cost-benefit study was made to determine the cost and effectiveness of radioactive waste (radwaste) treatment systems for decreasing the release of radioactive materials from a model enriched-uranium, light-water reactor (LWR) fuel fabrication plant, and to determine the radiological impact (dose commitment) of the released materials on the environment. The study is designed to assist in defining the term "as low as practicable" in relation to limiting the release of radioactive materials from nuclear facilities. The base case model plant is representative of current plant technology and has an annual capacity of 1500 metric tons of LWR fuel. Additional radwaste treatment equipment is added to the base case plants in a series of case studies to decrease the amounts of radioactive materials released and to reduce the radiological dose commitment to the population in the surrounding area. The cost for the added waste treatment operations and the corresponding dose commitment are calculated for each case. In the final analysis, radiological dose is plotted vs the annual cost for treatment of the radwastes. The status of the radwaste treatment methods used in the case studies is discussed. Some of the technology used in the advanced cases is in an early stage of development and is not suitable for immediate use. The methodology used in estimating the costs and the radiological doses, detailed calculations, and tabulations are presented in Appendix A and ORNL-4992. (auth)

13910 (ORNL-TM-4904) CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING "AS LOW AS PRACTICABLE" GUIDES: FABRICATION OF LIGHT-WATER REACTOR FUELS CONTAINING PLUTONIUM. Groenier, W. S.; Blanco, R. E.; Dahlman, R. C.; Finney, B. C.; Kibbey, A. H.; Witherspoon, J. P. (Oak Ridge National Lab., (USA)). May 1975. Contract W-7405-eng-26. 149p. Dep. NTIS $7.60.

A cost-benefit study was made to determine the cost and effectiveness of radioactive waste (radwaste) treatment systems for decreasing the release of radioactive materials from a model light-water plutonium recycle reactor fuel fabrication plant, and to determine the radiological impact (dose commitment) of the released materials on the environment. The study is designed to assist in defining the term "as low as practicable" in relation to limiting the release of radioactive materials from nuclear facilities. The base case model plant is representative of current plant technology and has an annual capacity of 300 metric tons of LWR plutonium recycle fuel. Additional radwaste treatment equipment is added to the base case plants in a series of case studies to decrease the amounts of radioactive materials released and to reduce the radiological dose commitment to the population in the surrounding area. The cost for the added waste treatment operations and the corresponding dose commitment are calculated for each case. In the final analysis, radiological dose is plotted vs the annual cost for treatment of the radwastes. The status of the radwaste treatment methods used in the case studies is discussed. Some of the technology used in the advanced cases is in an early stage of development and is not suitable for immediate use. The methodology used in estimating the costs and the radiological doses, detailed calculations, and tabulations are presented in Appendixes A and B. (auth)

13911 DECONTAMINATION OF RADIOACTIVE LIQUID WASTES BY CONTINUOUS ION EXCHANGE. Ryabchikov, B. E.; Trofimov, D. I.; Zakharov, E. I.; Dudin, A. S.; Mikheev, L. K. At. Energ. (USSR); 38: No. 4, 222-225(Apr 1975). (In Russian).

The construction of a transport pulsation sorption column and the scheme of an experimental installation based on such a column for decontaminating radioactive liquid wastes of low-level activity and of 1-m^3/hr capacity are described. The results of hydraulic and technological tests in the process of cation-exchange decontamination based on KY-2-8 resin are reported. It is shown that such a column, having a height of 10 m, makes it possible to achieve thorough decontamination of a solution at high specific capacity (30 to 40 $m^3/m^2 \cdot hr$) and practically full resin saturation. Continuous resin regeneration yielded 1.5 to 3 times richer regenerates than those obtained using fixed-bed filters of the same capacity. The tests carried out show that the apparatus developed is very efficient. (auth)

13912 APPARATUS FOR FIXING RADIOACTIVE WASTE. Murphy, J. D.; Pirro, J. Jr.; Lawrence, M.; Wisla, S. F. (to Atcor Inc.). US Patent 3,883,441. 13 May 1975. Filed date 20 Jul 1970. 4p.

Fixing radioactive waste is disclosed in which the waste is collected as a slurry in aqueous media in a metering tank located within the nuclear facilities. Collection of waste is continued from time to time until a sufficient quantity of material to make up a full shipment to a burial ground has been collected. The slurry is then cast in shipping containers for shipment to a burial ground or the like by metering through a mixer into which fixing materials are simultaneously metered at a rate to yield the desired proportions of materials. (auth)

Radioisotope Production

Refer also to abstract 13786.

13913 (CEA-N-1746, pp 3) REACTION OF FISSION PRODUCTS IN INORGANIC TARGETS. Cavallini, P.; Blachot, J.; Moussa, A. 1974. (In French).

In first semi-annual progress report 1974. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

Inorganic targets (UO_3, UCl_3, UF_4, UC, $UO_3 + UCl_3$, $UO_3 + RuCl_3$, $UO_3 + UF_4$, $UC + RuCl_3$), previously irradiated in the Melusine reactor, were heated for 5 minutes at 575°C, and the volatilization yields of the Zr, Nb, Mo, Tc, Ru, Xe, Te and I compounds were measured. The results are presented in a table. (FR)

13914 (CEA-N-1746, pp 4) SEPARATION OF THE FISSION PRODUCTS EMITTED FROM A ^{252}Cf SOURCE USING THE ISOTOPE SEPARATOR ISERE. Blachot, J.; Dousson, S.; Geronimi, R. 1974. (In French).

In first semi-annual progress report 1974. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

The fission fragments emitted from a ^{252}Cf source are collected on a Ta foil. The Ta foil is introduced into the high temperature ion source of the separator and the fission products are ionized, accelerated, and separated. (FR)

13915 (GSI-J-2-74, pp 114-124) CHEMICAL REACTIONS IN MELTS AND SOLIDS FOR THE SEPARATION AND IDENTIFICATION OF HEAVY ION REACTION PRODUCTS. Wolf, G. K.; Roemer, J.; Froeschen, W.; Fritsch, T.; Dreyer, I. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Chemical separation device for experiments in the heavy ion beam, application of oxide melts as targets for on-line mass-separation, and traps for heavy ion reaction products are described. (GE)

13916 (GSI-J-2-74, pp 136-149) SEPARATION OF NUCLEAR REACTION PRODUCTS IN THE GASEOUS PHASE. Baechmann, K.; Baier, K.; Boegl, W.; Buettner, K.; Campen, W.; Fehse, H. F.; Gebhartd, M.; Heinlein, G.; Helas, G.; Hoffmann, P. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Separation processes for a row of target elements and their products were investigated. The separation should be fast and selective. Separation and identification should go in a similar manner. Gaseous- and thermochromatographical methods and reactions with vessel coating are used for separation. (GE)

13917 (ORNL-5034) TRANSURANIUM PROCESSING PLANT SEMIANNUAL REPORT OF PRODUCTION, STATUS, AND PLANS

FOR PERIOD ENDING DECEMBER 31, 1974. King, L. J.; Bigelow, J. E.; Collins, E. D. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 29p. Dep. NTIS $4.00.

During the period July 1, 1974, through December 31, 1974, the following amounts of transuranium elements were recovered from 11 irradiated HFIR targets: 1.5 g ^{243}Am, 45 g ^{244}Cm, 24 mg ^{249}Bk, 252 mg ^{252}Cf, 1.25 mg ^{253}Es, and 0.5 pg ^{257}Fm. In addition, 34 mg of high-purity ^{248}Cm was separated from ^{252}Cf which had been recovered and purified during earlier periods. Nine HFIR targets, each containing 8 to 9 g of actinides (predominantly curium), were fabricated. Some of the chemical processing steps used for processing HFIR targets were added, deleted, or rearranged in order to reduce processing time and increase product yields. One cubicle equipment rack was replaced and the out-of-cell piping and equipment associated with the remotely operated valves in the TRU cubicles was revised. One neutron source was fabricated. Three sources that had been used previously in various projects and returned to TRU were reloaned. A special project was begun to recover ^{126}Sn from TRU process solutions. The values currently in use for transuranium element decay data and for cross-section data in planning irradiation-processing cycles, calculating production forecasts, and assaying products are tabulated in the Appendix. (auth)

13918 IMPURITIES IN ELUATES FROM ^{99}Mo–^{99m}Tc GENERATORS. Husak, V. (Univ. Hospital, Olomouc, Czech.); Dvorak, V. pp 79-84 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Results of half a year's measurements of radionuclidic purity in eluates from ^{99m}Tc generators are given and an attempt is made to assess the contribution of contaminants to the dose caused by the principal radionuclide. The results presented indicate that further more detailed evaluation of the dose contributions from contaminants of the solutions from generators is necessary. (ERB)

13919 GENERATOR-PRODUCED /sup 99m/TcO_4^-: CARRIER FREE. Lamson, M. L. III; Kirschner, A. S.; Hotte, C. E.; Lipsitz, E. L.; Ice, R. D. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 16: No. 7, 639-641(Jul 1975).

A solution of /sup 99m/TcO_4^-, as eluted from a ^{99}Mo-/sup 99m/-Tc radionuclide generator contains a greater chemical quantity of technetium than that attributable to the metastable isomer alone. The isomeric transition of the radionuclide of interest, /sup 99m/-Tc, gives rise to a determinable and chemically significant quantity of technetium carrier, ^{99}Tc. A method is presented for calculating the total chemical quantity of technetium in a generator eluate. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 13784, 13837, 13892, 14261, 14262, 15033, 15039, and 15040.

13920 (BARC-781) DESTRUCTION OF NITRIC ACID IN PUREX PROCESS STREAMS BY FORMALDEHYDE TREATMENT. Kumar, S. V.; Nadkarni, M. N.; Mayankutty, P. C.; Pillai, N. S.; Shinde, S. S. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

Efficiency of destruction of nitric acid in Purex Process streams with formaldehyde has been studied as a function of initial acidity, uranium concentration, rate of addition of formaldehyde and temperature in the range 6 to 0.5 M acid. Guidelines are suggested for the accurate calculations of the volume of formaldehyde needed to effect the required change of acidity at 100°C. Sodium nitrite has been established as a "key" to initiate the reaction and water as an effective scrubber for collecting the acid fumes emanating from the reaction vessel. (auth)

13921 (BARC-782) USE OF REDUCTANTS IN THE PURIFICATION OF URANIUM BY PUREX PROCESS. Kumar, S. V.; Nadkarni, M. N.; Ramanujam, A.; Venkatesan, M.; Gopalakrishnan, V.; Kazi, J. A. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.). 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

Counter current extraction studies were done on a laboratory scale to assess the usefulness of reducing agents like hydrazine, ferrous sulfamate, and uranous nitrate stabilized with hydrazine as scrubs in enhancing the uranium product purity during the final purification step by Purex process. Depleted uranium solution containing plutonium and fission product impurities as aqueous feed and 30% TBP in Shell Sol T as solvent was used in a twelve-stage mixer-settler unit. The extent to which parameters like feed acidity and organic uranium saturation would influence the product purity was studied. The capacity of the reductants as scrubs in giving the required uranium purity with respect to gross beta, gamma activities in the product decreased in the order: uranous nitrate > ferrous sulfamate > hydrazine. Even under higher feed acidity and lower level of organic uranium saturation, uranous nitrate stabilized with hydrazine (when used as scrub) was capable of giving a final product which was comparable to that obtained under low acid feed conditions. As for the plutonium removal, uranous nitrate and ferrous sulfamate were capable of giving uranium products with 0.05 μg Pu/g U when the feeds contained about 75 μg Pu/g U. Hydrazine scrub was suitable only for aqueous feeds having low plutonium content. (auth)

13922 (CEA-R-4666) EVALUATION OF THE EQUIVALENT DOSE RATES DUE TO NEUTRONS EMITTED BY PLUTONIUM OXIDE SOURCES: GRAPHS. Gouguet, J. (CEA Centre de la Hague, 50- Cherbourg (France)). Jun 1975. 54p. (In French). Dep. NTIS (US Sales Only) $5.75.

In irradiated fuel processing plants, the personnel concerned with radioprotection often require a rapid estimation of the equivalent dose rates due to neutrons emitted by plutonium oxide sources, sources having different physical and geometrical characteristics. Graphs are presented that facilitate rapid determinations. Graphs enabling the equivalent dose rates to be evaluated in contact with or at some distance from plutonium oxide sources of different geometrical characteristics are presented, the plutonium being obtained from fuels having been irradiated at different burnup in light water power reactors. (auth)

13923 (GA-A-13178) THORIUM UTILIZATION PROGRAM. Quarterly Progress Report for the Period Ending August 31, 1974. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1974. Contract AT(04-3)-167. 231p. Dep. NTIS $7.50.

This publication is the first of a quarterly series presenting results of work performed under the National HTGR Fuel Recycle Program (also known as the Thorium Utilization Program) at General Atomic Company. Results of work on this program were previously included in a quarterly series on the HTGR Base Program. The work reported includes the development of unit processes and equipment for reprocessing of High-Temperature Gas-Cooled Reactor (HTGR) fuel and the design and development of an integrated line to demonstrate the head end of HTGR reprocessing using unirradiated fuel materials. Work is also described on the evaluation of alternate techniques for fuel reprocessing to surmount possible operating problems with the reference flow sheet and the development of the conceptual design of a target recycle facility to identify the requirements of large-scale recycle of HTGR fuels. (auth)

13924 (GERHTR-93) ANALYSIS AND MATERIAL ACCOUNTING IN THE REPROCESSING OF HTGR NUCLEAR FUELS. Brodda, B. G.; Filss, P.; Kirchner, H.; Wenzel, U. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Dec 1973. Translation of JUL–1033–CT. 28p. Dep. NTIS $4.00.

Work performed under United States-German High Temperature Reactor Research Exchange Program.

A knowledge of the material balance of a reprocessing plant, in particular the fissile material balance, is required for various reasons. The methods to be used must be adapted to the technological conditions of the process, so that the underlying principles of general material accounting are virtually identical for purposes of process monitoring and the fissile materials safeguard system. For example, it is not possible to undertake any highly accurate uranium determination in the intact fuel element, although counting of the activity can be done very simply; during the extraction process, on the other hand, no digital recording of the fuel element count is possible, although an exact chemical uranium determination is. Since the reprocessing process is, in this connection, extremely inhomogeneous, it has been divided into material balance areas in order to arrive at a meaningful material balance accountancy and fissile materials safeguard system. (auth)

13925 (ICP-1069) INTERIM RESULTS: FINES RECYCLE TESTING USING THE 4-INCH DIAMETER PRIMARY GRAPHITE BURNER. Palmer, W. B. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). May 1975. Contract AT(10-1)-1375. 26p. Dep. NTIS $4.00.

The results of twenty-two HTGR primary burner runs in which graphite fines were recycled pneumatically to the 4-inch diameter pilot-plant primary fluidized-bed burner are described. The result of the tests showed that zero fines accumulation can easily be achieved while operating at plant equivalent burn rates. (auth)

13926 (JUL-1099-CT) TRITIUM IN FUEL REPROCESSING PLANTS. A Study on Inventory, Behaviour and Separation of the Superheavy Hydrogen Isotope. Schnez, H.; Laser, M.; Merz, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Aug 1974. 82p. (In German). INIS.

A quantitative description is presented of the way of tritium in reprocessing plants operated on the Purex and Thorex processes. For the Purex process, flowsheets are indicated which correspond to the present state of the art and provide for recycling of the aqueous phase and for separation of the tritium. As an alternative, advance separation of the tritium after fuel element chopping and separation from the aqueous phase are studied in technical and economical terms. The cost assessment also includes ultimate storage and transport of the tritium separated. The study concludes that there is a possibility for tritium separation. The financial expenditure is estimated to be less than DM 10/GWh, but may also be much higher because there is as yet no practical or industrial experience. (GE)

13927 (ORNL-TM-4901) CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING "AS LOW AS PRACTICABLE" GUIDES: NUCLEAR FUEL REPROCESSING. Finney, B. C.; Blanco, R. E.; Dahlman, R. C.; Kitts, F. G.; Witherspoon, J. P. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 174p. Dep. NTIS $7.60.

A cost-benefit study was made to determine the cost and effectiveness of radioactive waste (radwaste treatment systems for decreasing the release of radioactive materials from a model nuclear fuel reprocessing plant which processes light-water reactor (LWR) fuels, and to determine the radiological impact (dose commitment) of the released materials on the environment. The study is designed to assist in defining the term "as low as practicable" in relation to limiting the release of radioactive materials from nuclear facilities. The base case model plant is representative of current plant technology and has an annual capacity of 1500 metric tons of LWR fuel. Additional radwaste treatment systems are added to the base case plant in a series of case studies to decrease the amounts of radioactive materials released and to reduce the radiological dose commitment to the population in the surrounding area. The cost for the added waste treatment operations and the corresponding dose commitments are calculated for each case. In the final analysis, radiological dose is plotted vs the annual cost for treatment of the radwastes. The status of the radwaste treatment methods used in the case studies is discussed. Much of the technology used in the advanced cases is in an early stage of development and is not suitable for immediate use. The methodology used in estimating the costs and the radiological doses, detailed calculations, and tabulations are presented in Appendix A and ORNL-4992. (auth)

13928 (REG/G-3.30(6.75)) SELECTION, APPLICATION, AND INSPECTION OF PROTECTIVE COATINGS (PAINTS) FOR FUEL REPROCESSING PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 2p. NRC.

Protective coatings (paints) are used in fuel reprocessing plants to preserve from corrosion and erosion the surfaces of structures, systems, and components important to safety and to facilitate the removal of radioactive contamination from all such plant surfaces during plant operation, maintenance, and decommissioning. The practices acceptable to the NRC staff for the selection, application, and inspection of the protective coatings are described. (LK)

13929 PROCESS FOR ELECTRO-CHEMICALLY CUTTING AN IRRADIATED NUCLEAR FUEL ASSEMBLY. Wurm, J. G.; Van Impe, J.; De Coninck, A.; Heylen, P. R.; Rombaux, J. P. (to Centre d'Etude de l'Energie Nucleaire). US Patent 3,884,784. 20 May 1975. Priority date 1 Jul 1975, Belgium. 6p.

This invention relates to a process for electrochemically cutting an irradiated nuclear fuel assembly, in which an electrolyte is arranged between an electrode and the assembly to be cut, and an electric current is conducted between the assembly and the electrode, this process being characterized in that a molten oxidizing salt is used as electrolyte, in which a halide is dissolved as auxiliary agent. (auth)

13930 FUEL RECYCLING VEXES NUCLEAR INDUSTRY. Anderson, E. V. (C and EN, New York). Chem. Eng. News; 53: No. 28, 16-17(14 Jul 1975).

Delays in the regulatory decision on plutonium recycle, the question of safeguards, spent fuel storage problems, and the status of private US reprocessing plants are discussed. (MCG)

13931 PROCESS FOR THE ELIMINATION OF RADIOACTIVE IODINE IN NITRIC ACID SOLUTIONS. Cathers, G. I.; Shipman, C. J. (to USAEC, Washington, D. C.). French Patent 2,211,723/A/. 18 Dec 1973. 8p. (In French).

The procedure consists of diluting isotopically the solution by non-radioactive iodine in order to obtain a distillable concentration of iodine, about 2.5×10^{-5}, then sparging the iodine with ozone in order to oxidize it, and then distilling it all by sparging the solution with a gas capable of reducing the nitric acid to nitrogen oxide. This procedure is applicable to the reprocessing of fuels from a LMFBR reactor. (tr-FR)

13932 PROCESS CONTROL BY COMPUTER. Mache, H. R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). KFK-Nachr.; 6: No. 4, 8-9 (1974). (In German).

Experience with a model system for process control of separation processes in fuel reprocessing plants is described. (GE)

CONTROLLED THERMONUCLEAR RESEARCH

13933 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 9, No. 5, 1975. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 50p.

Plasma Confinement and Heating

13934 (AD/A-002744) STUDIES IN THE DYNAMICS AND RADIATION OF LASER HEATED PLASMAS. Final Report, 10 November 1972–9 November 1973. Tamor, S.; Byrne, R. N.; Latko, R. J. (Science Applications, Inc., La Jolla, Calif. (USA)). 14 Dec 1973. 125p. (SAI-73-648-LJ). NTIS $5.25.

An investigation into the dynamics and radiation of laser-heated plasmas is described. Part 1 is devoted to the description of a rate equation code which calculates the ionization buildup and radiation from a sample of material into which energy is deposited at a specified rate. In part 2 the development and applications of a 1-D HYDRO and radiation code is described. This is a multi-region code which calculates the laser propagation and energy deposition, heating, hydrodynamics and radiation from a laser heated pellet. (GRA)

13935 (CEA-CONF-2912) T.T.M.P. EXPERIMENT ON PETULA. Parlange, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1974. 14p. INIS.

From summer school symposium on plasma heating in toroidal devices; Varenna, Italy (3 Sep 1974).

The device Petula, specially built to study heating by T.T.M.P. and to adapt it to confinement, is a medium sized Tokamak. The apparatus and the results expected are described: energy distribution of the particles not affected in the case of low magnetic modulation; better heating yield for a higher ion temperature. The efficiency improves as the size of the apparatus increases: process low and nearly uniform in space (no resonant layer). Possible initiation conditions for a 50% deuterium, 50% tritium plasma with a 4 coil system, the equilibrium temperatures when initiation cannot be achieved because of energy losses and, for coils of different diameters, the power dissipated and coil voltages are given. (FR)

13936 (COO-2081-27) DYNAMICS OF ION-CYCLOTRON RESONANCE HEATING. Ciarvella, M. J. (Colorado Univ., Boulder (USA)). May 1975. Contract AT(11-1)-2081. 14p. Dep. NTIS $4.00.

If tokamaks as large as PLT are heated by the slow ion cyclotron wave, nonlinear effects must be considered. Some problems of nonlinear particle dynamics are discussed. (auth)

13937 (EUR-5236e) PRESENT STATE OF RESEARCH INTO PLASMA HEATING AND INJECTION METHODS. (Commission of the European Communities, Luxembourg). 1974. 130p. Dep. NTIS (US Sales Only) $9.50.

The advantages and disadvantages recognized by the Advisory Group on Heating and Injection for twelve plasma heating and injection methods currently under investigation in Europe are related. The heating and injection requirements of four reference reactor designs are previously defined. The problems which arise when one attempts to extrapolate existing work towards the reactor goal are emphasized. Two refueling methods not directly linked with the heating problem are discussed. The experiments in operation or under construction in Europe in which each method is investigated are listed. Sixteen working papers which served as a basis for the Advisory Group discussion and which cover all the heating and injection methods examined are included. (auth)

13938 (IC-73-124) PLASMA HEATING BY INTENSE RELATIVISTIC ELECTRON BEAMS. Rudakov, L. I.; Sudan, R. N. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1973. 13p. INIS.

The application of intense relativistic electron beams to (a) heating of solid DT pellets and (b) heating of plasmas by collective processes in the density range $10^{15} \sim 10^{18}$ cm^{-3} are discussed. (INIS)

13939 (MATT-1136) COMMENTS ON ENERGY CONFINEMENT OF TOKAMAKS IN THE TRAPPED ELECTRON REGIME. Okabayashi, M. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Jul 1975. Contract AT(11-1)-3073. 10p. Dep. NTIS $4.00.

Some discussion is made to estimate the energy confinement properties of large Tokamak devices in the trapped electron regime based on the experimental results of the spherator. The generalized empirical formula of the spherator predicts in the trapped electron regime the energy confinement time τ_E is independent of ohmic heating current I_{OH} and the electron temperature T_e, and depends only on the size of the plasma radius a. The electron temperature T_e is increased with an increase of I_{OH}. These predicted formulas are $\tau_E \simeq 0.5\ a^2$ (m) I^0_{OH} (MA) T^0_e (keV) and T_e (keV) $\simeq 2.0\ a^{-1}$ (m) I_{OH} (MA). The energy confinement time for PLT is predicted to be 70 ~ 90 msec with T_e ~ 4 keV and the value for TCT to be 300 ~ 400 msec with T_e ~ 7 keV. (auth)

13940 (MATT-1145) REACTOR ASPECTS OF COUNTER-STREAMING-ION TOKAMAK PLASMAS. Jassby, D. L. (Princeton Univ., N. J. (USA). Dept. of Physics). Jun 1975. Contract AT(11-1)-3073. 49p. Dep. NTIS $5.50.

Toroidal DT plasmas in which the D and T ions make up two distinct, quasi-thermal velocity distributions, oppositely displaced in velocity along the magnetic axis, are discussed. Such counterstreaming distributions can be set up by introducing all ions from the plasma shortly after they have decelerated to an energy approximate to or less than 2T/sub e/ by Coulomb drag on the plasma electrons. A simple physical model for counter-streaming-ion operation is postulated, which allows one to deduce the ion velocity distributions and required energy and particle confinement times that are in good agreement with the results of previous Fokker-Planck calculations. The variations of fusion reactivity, power gain, and power density with injection energy and electron temperature are presented. The practical problems of implementing counter-streaming operation in a tokamak, such as charge-exchange losses, the prompt removal of cold ions, and the effect of impurities are discussed. (auth)

13941 (ORNL-TM-4967) DOUBLE QUANTUM JUMP IN CTR. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

Plasma density and confinement times necessary for operating fusion reactors are discussed. One method for increasing densities and confinement time is that of plasma exponentiation. In this process the injected current is increasingly trapped on its own previously trapped plasma and a density runaway to very high values may occur provided the exponential condition is maintained and instabilities are not too severe. The plasma exponential conditions are discussed. (MOW)

13942 (TRITA-EPP-74-22) TORNADO TRAPS OPERATED AS ROTATING PLASMA DEVICES. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). 6 Dec 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

The possibility is being discussed of creating and heating the plasma in "Tornado" magnetic traps by means of the rotating plasma technique. On account of the particular field geometry of these traps, it is likely that the critical velocity phenomenon of rotating plasmas can be avoided. (auth)

13943 (TRITA-EPP-74-24) EXPERIMENTS ON MAGNETO-ACOUSTIC RESONANCES IN A ROTATING PLASMA. Tennfors, E.; Bergstroem, J.; Bures, M. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Dec 1974. 32p. Dep. NTIS (US Sales Only) $4.75.

An external ringing resonance circuit was coupled to a rotating fully ionized hydrogen plasma. The damping of the oscillations is a measure of the coupling between the external circuit and the plasma. The frequency of the oscillations was varied and absorption spectra were obtained for some different coupling coil structures. Absorption peaks were identified with various magneto-acoustic modes. The dependence of the coil structure was observed. In the high frequency end of the variation interval for the external circuit a strong resonance seems to appear. This may be related to the ion cyclotron frequency, but the present external circuit works poorly in this region. (auth)

13944 HOT ION PLASMA HEATING EXPERIMENTS IN SUMMA. Reinmann, J. J.; Lauver, M. R.; Patch, R. W.; Posta, S. J.; Snyder, A.; Englert, G. W. (Lewis Research Center, Cleveland). IEEE Trans. Plasma Sci.; PS-3: No. 1, 6-14(Mar 1975).

Initial empirical results are presented for the hot-ion plasma heating experiments conducted in the new SUMMA (Superconduct-

ing Magnetic Mirror Apparatus) at NASA Lewis Research Center. A discharge was formed by applying a radially inward dc electric field near the mirror throats. Data were obtained at midplane magnetic flux densities from 1.0 to 3.5 tesla. Charge-exchange neutral particle energy analyzer data were reduced to ion temperatures using a plasma model that included a Maxwellian energy distribution superimposed on an azimuthal drift, finite ion orbits, and radial variations in density and electric field. Using this plasma model, the highest ion temperatures computed were 5 keV, 1.2 keV, and 1 keV for He^+, H_2^+, and H^+, respectively. These were obtained at a midplane magnetic flux density of 1.6 T. Ion temperature was found to scale roughly as (P/B)/sup n/, where P/B is the ratio of power input to magnetic flux density and n is about 1 for hydrogen and 2 for helium. Optical spectroscopy line-broadening measurements yielded ion temperatures about 15 percent higher than the charge-exchange neutral particle analyzer results for hydrogen and about 50 percent higher for helium. Spectroscopically obtained electron temperatures ranged from 3 to 30 eV. (auth)

13945 THEORETICAL PREDICTION OF THE OBSERVED PLASMA HEATING IN THE COMPRESSION EXPERIMENT AT ITO'S GROUP AT OSAKA UNIVERSITY. Alexeff, I. (Nagoya Univ., Japan). IEEE Trans. Plasma Sci.; PS-3: No. 1, 15-17 (Mar 1975).

A simple, model-independent description of the compression experiment of Ito's group at Osaka University predicts the observed plasma heating and final plasma beta to within a factor of two. (auth)

13946 PLASMA CONFINEMENT IN A HIGH MAGNETIC FIELD TOROIDAL QUADRUPOLE. Lubin, M. J. (Univ. of Rochester, NY); Friedman, W.; Roberts, M.; Alexeff, I. Phys. Fluids.; No. 13, 3054-3058(Dec 1970).

Plasma (n less than 10^{11} cm^{-3}, T/sub e/ less than 100 eV) in integral dl/B stable region shows two decay times, tau/sub fast/ (20 mu sec) followed by tau/sub slow/ (120 mu sec, at constant T/sub e/). Where Debye length exceeds electron Larmor radius, tau approximately B^2 with particle loss mainly radial, below that field, tau approximately B/sup 1/3/. (auth)

13947 DISSIPATION OF OSCILLATION ENERGY BY MAGNETOSONIC HEATING OF PLASMA IN THE TO-1 TOKAMAK. Ivanov, N. V.; Kovan, I. A. At. Energ. (USSR); 38: No. 4, 229-233(Apr 1975). (In Russian).

Energy dissipation of natural magnetosonic oscillations of plasma columns in the TO-1 Tokamak was investigated. The plasma-resonator was measured and its dependence on discharge parameters obtained. The mechanism of dissipation is discussed. (auth)

13948 EFFECT OF GAS ADSORBED ON THE WALLS OF A TOKAMAK ON PLASMA DENSITY BEHAVIOR. Ivanov, N. V.; Kovan, I. A. Sov. At. Energy (Engl. Transl.); 37: No. 2, 860-861(Aug 1974).

Translated from At. Energ.; 37: No. 2, 161(Aug 1974).

Discharge pulses were compared whose initial conditions varied only in the amount of gas adsorbed on the walls of the discharge chamber. Diagrams are given of the time variation of the averaged plasma density in the discharge for various values of the initial gas pressure in the tokamak chamber. (MOW)

13949 LOWER HYBRID RESONANCE HEATING IN A HOT ELECTRON PLASMA. Raimbault, P. A.; Shohet, J. L. (Univ. of Wisconsin, Madison). Plasma Phys.; 17: No. 5, 327-344 (May 1975).

Lower hybrid resonance heating of a hot electron plasma was studied both theoretically and experimentally. R.f. power was found to transfer primarily to the electrons, but when the electron absorption was decreased by increasing the electron temperature a small amount of ion heating occurred. The electron absorption characteristics are very similar to those for lower-off-resonance heating and were determined to be those of collisionless absorption in the low density region outside of the hybrid layer. (auth)

13950 GEOMETRIC RESONANCES NEAR THE LOWER HYBRID FREQUENCY. Kraemer, M. (Univ., Bochum, Ger.). Plasma Phys.; 17: No. 5, 373-392(May 1975).

Radio frequency waves at extremely low power and near the lower hybrid frequency are coupled inductively to a plasma cylinder. The dominance of geometric resonances is verified. The strength of anomalous damping is observed to be related to the steepness of radial density gradients; a qualitative explanation by means of linear mode conversion is discussed. (auth)

13951 OPTIMIZATION OF PERMANENT MAGNET PLASMA CONFINEMENT. Leung, K. N.; Samec, T. K.; Lamm, A. (California Univ., Los Angeles (USA). Dept. of Physics). Phys. Lett., A; 51: No. 8, 490-492(5 May 1975).

Confinement of plasma by permanent magnets is studied with three magnet geometries. Full line cusps are found to give optimum plasma density. Increase in density is primarily due to confinement of primary electrons. (auth)

13952 THE INTERACTION OF A LARGE AMPLITUDE TRAVELLING WAVE WITH A CYLINDRICAL PLASMA. Finken, K. H.; Stampa, A.; Tuczek, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Plasmaphysik). Z. Naturforsch., A; 30: No. 2, 195-203(Feb 1975).

In connection with the problem of radio frequency heating of plasma, the interaction of a high power wave (0.1 GWatts) with a cylindrical plasma is investigated experimentally for frequencies near the ion cyclotron frequency and in the region between the ion cyclotron frequency and the lower hybrid frequency. It is found that a geometric resonance can be excited in which more than 90% of the wave energy is absorbed by the plasma. At frequencies around the ion cyclotron frequency, the macroscopic properties of the plasma, including distortion of the wave by large amplitude effects, can be fairly well explained by a MHD-model assuming an anomalous resistivity. The enlarged collision frequency is attributed to the presence of turbulence which is excited by drift currents connected with the wave. (GE)

13953 DECAY INSTABILITIES NEAR THE HYBRID RESONANCES IN A PLASMA WITH TWO SPECIES OF IONS. Chan, V.S.; Seshadri, S.R. (Department of Electrical and Computer Engineering, The University of Wisconsin, Madison, Wisconsin 53706). J. Appl. Phys. 46: No. 7, 2903-2909 (July 1975).

The decay instabilities near the hybrid resonances in a homogeneous plasma with two species of ions and permeated by a uniform magnetostatic field are investigated for the case in which an ordinary mode is the pump wave. The extraordinary mode consists of four branches, namely, a high-frequency branch, an intermediate-frequency branch having a resonance at the upper hybrid resonant frequency, and two low-frequency branches having resonances at the first lower hybrid resonant frequency and the Buchsbaum two-ion hybrid resonant frequency, respectively. The ordinary mode can couple only with the intermediate frequency branch and the two low-frequency branches of the extraordinary mode in the presence of the pump. These couplings result in decay instabilities if the interacting waves propagate in opposite directions. Numerical results are presented to illustrate the characteristics of the parametrically excited instabilities near the first lower hybrid resonant frequency and the Buchsbaum two-ion hybrid resonant frequency. The dependences of the maximum growth rates of these instabilities on the strength of the magnetostatic field are also examined. (auth)

13954 THERMALIZATION OF A SPARK DISCHARGE. Hill, R.D. (P. O. Box 5484, Montecito, California 93108). J. Appl. Phys. 46: No. 7, 2910-2914 (July 1975).

A thermalization process that depends on both localized and channelized Ohmic heating of a plasma in a spark discharge is proposed. A satisfactory quantitative description of a spark current pulse observed in a recent experiment by Barreto, Reynolds, and Jurenka is given in terms of the proposed process. (auth)

13955 ION CONFINEMENT BY ELECTROSTATIC POTENTIAL WELL IN MAGNETIC MULTIPOLE DEVICE. Nakamura, Y.; Quon, B. H.; Wong, A. Y. (California Univ., Los Angeles (USA). Dept. of Physics). Phys. Lett., A; 53: No. 1, 85-86 (19 May 1975).

An effective confinement of fast ions is achieved by a negative electrostatic potential well produced by injection of electrons into a surface magnetic multipole device. (auth)

13956 RADIO-FREQUENCY ABSORPTION IN A PLASMA CONFINED BY RF PLUGS. Golovanivskii, K.S.; Dougar-Jabon, V.D.; Pokhmel'nykh, L.A. (Patrice Lumumba Friendship of Nations University, Moscow). Sov. Phys.—Tech. Phys. 19: No. 11, 1484-1485 (May 1975).

The absorption of radio-frequency energy is investigated in a plasma with energetic ions which is confined by radio-frequency plugs operated at the electron cyclotron resonance (ECR). With a magnetic field gradient of 10—40 G/cm in the ECR region and with longitudinal ion energies of 1 keV the plasma reflection is essentially elastic. (auth)

13957 ION HEATING IN A TRAIN OF ORTHOGONAL MAGNETOACOUSTIC SHOCKS. Boozer, A.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 18: No. 7, 919-919 (July 1975).

The deposition of energy from a train of magnetoacoustic waves, which have steepened to form shocks, is considered in a collisionless plasma. It is shown that an initially lower ion temperature tends to rise to a value comparable to the electron temperature. (auth)

13958 MECHANISM FOR ION TAIL FORMATION DURING ION-ACOUSTIC TURBULENCE. Choi, D.; Horton, W. Jr. (Fusion Research Center, Department of Physics, The University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 18: No. 7, 858-860 (July 1975).

An acceleration mechanism producing ion tails during turbulent heating experiments is proposed. The implication of the theory in terms of the pulsed nature of the heating is shown by a simple example. (auth)

13959 LASER HEATING OF A MAGNETICALLY CONFINED PLASMA. Yuen, S.Y.; Lax, B. (Department of Physics and Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Cohn, D.R. Phys. Fluids 18: No. 7, 829-836 (July 1975).

The problem of laser heating of a plasma is considered in the low β limit. Spatial and temporal variations of electron as well as ion temperatures are calculated, and the shape of the laser pulse is varied to find an optimal ion heating condition. The propagation of the "bleaching wave" into the plasma column is also investigated. By an iterative approximation analytic expressions are obtained for quantities such as particle temperatures, hole burning velocity, penetration depth, and the equilibration time of electron and ion temperatures after the laser is tuned off. They can be used to find various restricted optimization conditions. (auth)

13960 PONDEROMOTIVE FORCE EXERTED ON A PLASMA BY AN INFRARED LASER BEAM. Marhic, M.E. (School of Engineering and Applied Science, University of California, Los Angeles, California 90024). Phys. Fluids 18: No. 7, 837-845 (July 1975).

The continuum and single particle approaches to the ponderomotive force in an underdense plasma are presented. The force density tends to expel the plasma out of a focused laser beam. Transient and steady-state responses of the plasma to the ponderomotive force are studied, and the importance of $\alpha = (\omega_p^2/\omega^2)\langle\epsilon_0(E^2/2)\rangle/2n_eKT$ is emphasized. Experimental verifications are presented, obtained with a pulsed CO_2 laser-amplifier system (500 MW) irradiating an argon arc plasma ($n_e = 3\times10^{14}$ cm^{-3}, $T=1.4$ eV). Density changes are monitored by studying light emitted from the focal region, and the measured decrease in light intensity is consistent with the plasma density decrease expected for a value of $\alpha=0.37$. (auth)

13961 LASER RADIATION FORCES IN LASER-PRODUCED PLASMAS. Stamper, J.A. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 18: No. 6, 735-740 (June 1975).

There are two contributions to laser radiation forces acting on the electrons. Transfer of momentum from the fields to the electrons results in a field pressure contribution and occurs whenever there is absorption or reflection. The quiver pressure contribution, associated with electron quiver motion, is due to inhomogeneous fields inducing momentum transfer within the electron system. It is shown that the ponderomotive force with force density, $[(\epsilon-1)/8\pi]\nabla\langle(\delta E)^2\rangle$, does not include the field contribution and does not lead to a general description of macroscopic processes. A theory is discussed which does give a general macroscopic description (absorption, reflection, refraction, and magnetic field generation) and which reduces to the ponderomotive force for purely sinusoidal fields in a neutral, homogeneous, nonabsorbing plasma. (auth)

13962 OBSERVATIONS OF PLASMA HEATING IN A TURBULENT TORUS. Bengtson, R.D.; Gentle, K.W.; Jancarik, J.; Medley, S.S.; Nielsen, P.; Phillips, P. (Fusion Research Center, University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 18: No. 6, 710-716 (June 1975).

The Texas turbulent torus is a device to turbulently heat a plasma and maintain the heating current to confine the plasma in a tokamak configuration. Initial results show penetration of the heating current at densities up to 10^{13} cm^{-3}, heating of the electrons to temperatures of order 10 keV, and the heating of a fraction of the ions to temperatures of several keV. (auth)

13963 ANOMALOUS HEAT CONDUCTION ALONG THE FIELD LINES FOR TURBULENTLY HEATED PLASMAS. Caponi, M.Z. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Krall, N.A. Phys. Fluids 18: No. 6, 699-709 (June 1975).

A quasi-linear model is presented to study the effect of turbulence and finite length on heat loss by conduction along the field lines in a plasma heated by cross-field instabilities. The turbulence contribution to energy confinement along the field lines is calculated self-consistently from the quasi-linear moment equation. The electron temperature is found to be highly dependent on the competition between heat loss to the ends and turbulent heat production due to the instabilities. The results, discussed for a wide range of plasma parameters, may explain the cooling of electrons on the time scale of interest (e.g., implosion time) in several theta-pinch experiments. (auth)

13964 ENHANCED SCATTERING INHERENT TO "LOSS-CONE" ION DISTRIBUTIONS— GENERAL GEOMETRY. Baldwin, D.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 18: No. 6, 656-660 (June 1975).

The ion scattering rate due to the Post–Rosenbluth convective loss-cone instability is calculated for general geometry. Noise generated by particle discreteness is amplified by the instability, the details of which are sensitively dependent upon the spatial variation of plasma parameters. Ray equations are developed for the transport and amplification of wave energy. (auth)

13965 EXPERIMENT ON THE INTERACTION BETWEEN A PLASMA AND A NEUTRAL GAS. II. Danielsson, L.; Brenning, N. (Department of Plasma Physics, Royal Institute of Technology, Stockholm 70, Sweden). Phys. Fluids 18: No. 6, 661-671 (June 1975).

An interaction between a plasma and a neutral gas in relative motion is demonstrated. If the relative velocity is high enough, the interaction leads to heating of the electrons, partial ionization of the gas, and braking of the motion. The limiting velocity is found to be very close to Alfvén's critical velocity. Two new means of plasma diagnostics are tried for the first time in this experiment. Measurements of the polarization of emitted spectral lines have yielded information on the velocity distribution of the electrons. An ion beam interaction technique has been employed to determine the density of energetic electrons. New evidence is also presented of electron heating and of the necessity of a magnetic field for the interaction to take place. The previously observed minimum gas density is also discussed. (auth)

13966 HEATED ELECTRON DISTRIBUTIONS FROM RESONANT ABSORPTION. DeGroot, J.S.; Tull, J.E. (Department of Applied Science, University of California, Davis, California 95616). Phys. Fluids 18: No. 6, 672-678 (June 1975).

A simplified model of resonant absorption of obliquely incident laser light has been developed. Using a 1.5 dimensional electrostatic simulation computer code, it is shown that the inclusion of ion motion is critically important in determining the heated electron distributions from resonant absorption. The electromagnetic wave drives up an electron plasma wave. For long density scale lengths ($L\simeq10^3\lambda_{De}$), the phase velocity of this wave is very large ($\omega/k\gtrsim10V_{th}$) so that if heating does occur, a suprathermal tail of very energetic electrons is produced. However, the pressure due to this wave steepens the density profile until the density gradient scale length near the critical density (where the local plasma frequency equals the laser frequency) is of order $20\lambda_{De}$. The electrostatic wave is thus forced to have a much lower phase velocity ($\omega/k\simeq2.5V_{th}$). In this case, more electrons are heated to much lower velocities. The heated electron distributions are exponential in velocity space. Using a simple theory it is shown that this property of profile steepening applies to most of a typical laser fusion pulse. This steepening raises the threshold for parametric instabilities near the critical surface. Thus, the extensive suprathermal electron distributions typically produced by these parametric instabilities can be drastically reduced. (auth)

Plasma Diagnostics

Refer also to abstracts 14021 and 15399.

13967 (AD/A-000698) LOW ENERGY X RAY AND ELECTRON PHYSICS FOR MATERIALS ANALYSIS. Final Report, 1 December 1971–30 Jun 1974. Henke, B. L.; Tester, M. A. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Oct 1974. 19p. (AFOSR-TR-74-1782). NTIS $3.25.

This period was directed to research, independent and collaborative in the application of low energy x-ray and electron physics to the following areas: (1) surface state, molecular and solid state analysis by ultrasoft x-ray spectroscopy; (2) development of methods for quantitative photoelectron spectroscopic analysis for surface structure and chemistry; and (3) the development of techniques for high temperature plasma diagnostics by low energy x-ray spectroscopy. Activities, some results, and techniques and equipment are briefly described. (GRA)

13968 (AD/A-002292) X-RAY DIAGNOSTICS FOR LASER SYSTEMS. Final Report, 15 May 1972–30 April 1974. Chase, L. F.; Bardin, R. K.; Fisher, T. R.; Grench, H. A.; Jordan, W. C. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab). Apr 1974. Contract DNA001-72-C-0211. 123p. (LMSC-D-401229; DNA-3404F). NTIS $5.25.

Instrumentation specifically designed to measure the x-ray output generated by laser-produced plasmas is discussed. High-resolution x-ray spectra, laser to x-ray efficiency, x-ray angular distributions, and 75-ps x-ray time histories were systematically obtained using a wide range of targets (Al, V, Fe, Cu, Zn, Ge, Zr, Nb, Mo, Ag, Sn, W, and Au). Results are presented, and the particular instrumentation used in obtaining the data is described. A multichannel curved-crystal spectrograph, calorimeters, and fast time histories are described. (GRA)

13969 (AD/A-002729) FEASIBILITY STUDY OF 300 TO 1000 eV ELECTRON TEMPERATURE MEASUREMENTS OF A LOW-DENSITY (N about = to the 14th power/cc) TRANSIENT (T about = 100 nsec) PLASMA IN THE "TRITON" EXPERIMENT USING BERYLLIUM FOILS, L-EDGE ROSS FILTERS AND PHOTOELECTRIC DETECTORS. Logan, B. G.; Gerber, K. A. (Naval Research Lab., Washington, D. C. (USA)). Nov 1974. 41p. (NRL-MR-2917). NTIS $3.75.

Various techniques of low-energy x-ray measurements useful in the determination of electron temperatures were evaluated for application to the energetic (300 to 1000 eV) low-density ($N = 10^{14}$/cc) transient (T = 100 nsec) plasma in the "Triton" electron beam-plasma interaction experiment. Diagnostic techniques considered include continuum measurements with broad-band beryllium-foil filters, narrow band-pass absorption-edge filters for x-ray energies below 1 KeV and gold photoelectric detectors for energies below 400 eV. (GRA)

13970 (GSI-J-2-74, pp 198-216) PLASMA INVESTIGATIONS ON THE MPIG. Fuchs, G.; Herbert, H. C.; Wiesemann, K. Nov 1974. (In German).

14 figs.; 5 refs.

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Measurements on the MPIG are reported. A plasma is produced by electron beam injection into a gas in a magnetic bottle. This plasma is investigated by x-ray spectroscopy and microwave analysis. (GE)

13971 (IPP-4/81) INVESTIGATION OF LASER-TARGET INTERACTIONS WITH PICOSECOND MICROPHOTOGRAPHY. Ariga, S.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Mar 1975. 4p. (AED-CONF-75-043-024). INIS.

From spring meeting of the Fachauschuesse Kurzzeitphysik and Plasma- und Gasentladungsphysik of the DPG; Duesseldorf, F. R. Germany (4 Mar 1975).

5 figs.; 1 ref. With abstract.

The investigation of the interaction between the laser light and the pellet in laser-fusion experiments, whose typical time scale is approximately 100 ps, requires high-speed diagnostics. In this work a 5 ps single pulse from a dye laser pulse train was utilized for time-resolved microphotography. The spatial resolution obtained was better than 5μm. The technique was applied to investigate plasmas produced by a 20 J/5 ns Nd-glass laser pulse with solid targets of deuterium and other materials. Expansion of plasmas, blow-off of target materials with velocities up to 10^7 cm/s, and propagation of shock waves in targets could be studied. (GE)

13972 (LA-tr-75-25) DIAGNOSTICS OF LINEAR Z-PINCH DISCHARGE BY THE METHOD OF SCATTERING OF LASER RADIATION. Aleksandrov, V. V.; Gorianov, A. I.; Koval'skii, N. G.; Luk'ianov, S. Iu.; Rantsev-Kartinov, V. A. Translated by Helen J. Dahlby Diagn. Plazmy; 3: 200-206(1973). 13p. Dep. NTIS $4.00.

The method of scattering laser radiation was used to determine the plasma parameters of a linear Z-pinch discharge at maximum compression. The characteristic lifetime of the compressed plasma (tens of nanoseconds) and its dimensions ($d \simeq 1$ cm) made the application of the laser scattering techniques especially attractive. (auth)

13973 (PB-237560) NONEQUILIBRIUM IN A FREE-BURNING ARGON ARC PLASMA. Final Report, 1 April 1972–30 November 1974. Chan, P. W.; Niimura, M.; Schanberg, B. C. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). Nov 1974. 51p. NTIS $4.25.

The axial distributions of the electron temperature and number density a free-burning argon arc plasma at atmospheric pressure were measured experimentally using a Thomson scattering technique. The axial temperature distribution was also measured spectroscopically by the relative line intensity method. The results are presented in terms of the degree of nonequilibrium distribution shifted from the calculated Saha equilibrium temperature and the heavy particle temperature at different spatial positions along the axis of the arc. It is shown that the temperatures as measured by light scattering are different from those measured by relative line intensity ratio method. The difference is ascribed to the nonequilibrium of the arc as well as to the special geometry of the arc. (GRA)

13974 TECHNIQUE TO MEASURE SUBMILLIMETER TOKAMAK SYNCHROTRON RADIATION SPECTRA. Blanken, R. A.; Brossier, P.; Komm, D. S. (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Electr. Electron. Eng.) Trans. Microwave Theory Tech.; MTT-22: No. 12, 1057-1060(Dec 1974).

A wire-mesh Fabry–Perot interferometer with millisecond response time was constructed. The application of this instrument to study the millimeter and submillimeter synchrotron radiation emitted by magnetically confined Tokamak plasmas is discussed. (auth)

13975 INTERFEROMETRY AT 337 mu m ON A TOKAMAK PLASMA. Brossier, P.; Blanken, R. A. (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Electr. Electron. Eng.) Trans. Microwave Theory Tech.; MTT-22: No. 12, 1053-1056(Dec 1974).

The Alcator electron density (10^{13} less than n/sub e/ less than 10^{14} cm^{-3}) was measured with a 337-mu m Mach–Zender interferometer is given. Results are discussed and compared with microwave interferometry data. (auth)

13976 SPECTROSCOPIC DETERMINATION OF ELECTRON TEMPERATURE AND DENSITY IN NON-THERMAL PLASMAS. Norton, B. A.; Wooding, E. R. (Royal Holloway Coll., London). pp 601-605 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

A method is described for deducing the electron temperature (T_e) and density (n_e) in plasmas from the relative intensities of a limited number of lines which originate from more than one ionization stage of a plasma component. T_e and n_e have been determined in this way in a Carbon-Fluorine plasma using the Carbon II and III lines at 4267 Å, 2297 Å and 5696 Å and are in close agreement with values derived from other detailed line intensity ratios and from a measurement of the electrical conductivity. If C, N and O are considered, this method covers a temperature range of ~2 eV to ~11 eV. Higher values of T_e can be measured using other line ratios. (UK)

13977 BEHAVIOUR AND CORRECT USE OF ELECTROSTATIC PROBES IN RADIOFREQUENCY PLASMAS. Cantin, A.; Gagne, R. R. J. (Laval Univ., Quebec City, Can.). pp 625-629 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

A study is reported which has been made into the properties of electrostatic probes for non-flowing collision-dominated plasma where their behaviour is only partly understood. The choice of plasmas produced without electrodes by radio frequency fields was made on the basis of their possible cleanliness. The equipment used, the effect of r.f. voltage on electrostatic probe I–V characteristics and the correct use of electrostatic probes in r.f. discharges are discussed. (UK)

13978 POTENTIAL OF PULSATING POINT CHARGE IN WARM ISOTROPIC PLASMA. Fiala, V. (Geophysical Inst., Prague). Czech. J. Phys.; B25: No. 1, 51-56(1975).

An expression for the potential of a pulsating point charge in a warm isotropic plasma known from previous work is derived in an independent way. This approach offers a possibility to calculate the plasma response as a Laplace instead of Fourier integral and may give some insight even into problems without spherical symmetry. (auth)

13979 INSTALLATION FOR DIAGNOSTICS OF PLASMA IN ION SOURCES. Abroyan, M. A.; Kolokolov, N. B.; Lavrov, B. P.; Lozovoi, S. I. Vestn. Leningrad. Univ., Fiz., Khim.; 22: No. 4, 28-38(Nov 1974). (In Russian).

A description is given of an installation for combined Langmuir probe and optical investigation of plasma properties in mono- and duoplasmatron arc discharges. Different possibilities of plasma diagnostics under these conditions are discussed. Some preliminary results of spatially resolved measurements of charged-particle density, electron energy distribution and populations of atomic hydrogen excited states are reported. (auth)

13980 ACTIVE DIAGNOSIS OF PLASMAS BY LASER RADIATION. Burakov, V. S.; Nechaev, S. V. Zh. Prikl. Spektrosk.; 22: No. 1, 31-36(Jan 1975). (In Russian).

The possibility of using the energy of the limiting absorption saturation from the ground state of atomic systems for the determination of the concentration of absorbing centers in plasma and for evaluation of its preheating temperature under the effects of laser pulses was shown. The justification of the method was made on the basis of the solution of the critical and balance equations for K atoms subjected to the effects of intense electromagnetic waves. The method was confirmed experimentally with plasmas enriched in K and excited by non-focused electrical discharge in capillaries. The probing of the plasma was achieved by radiation of an organic solution laser with generation in the

region of the resonance doublet of K. The satisfactory agreement of the results obtained by this method with the known models of non-homogeneous sources was shown. (tr-auth)

13981 SUBMILLIMETER LASER INTERFEROMETER FOR PLASMA DIAGNOSTICS. Kolerov, A. N.; Petrov, G. D. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 6, 106-109 (Jun 1974).

Translated from Radiotekh. Elektron.; 19: No. 6, 1282-1286 (Jun 1974).

A method was developed for determining the electron density N_e in a low-temperature plasma by a submillimeter three-mirror laser interferometer (SBM TLI) with a lasing wavelength of $\lambda = 337$ μm. The construction of the measuring equipments is described, and the results of measurements in a gasoline burner flame and in a vacuum arc discharge, placed in a magnetic field, are presented. The Faraday effect was used in the latter case, and the SBM TLI operated as a multiple-pass polarization interferometer. The sensitivity, accuracy and operating range of the systems are evaluated. (auth)

13982 COMMENTS ON "CONTINUUM THEORY OF SPHERICAL ELECTROSTATIC PROBES IN A STATIONARY, MODERATELY IONIZED PLASMA". Ingold, J. H. (General Electric Company, Cleveland). Phys. Fluids; 18: No. 5, 616(May 1975).

A boundary condition used in earlier papers by Barad and Cohen (Phys. Fluids; 17: 724(1974)) is discussed. Some equations discussed in this paper are shown to be the same as those derived by the author in a later paper. (MOW)

13983 EXPERIMENTAL MEASUREMENTS OF THE RADIAL DENSITY DISTRIBUTION IN A NONNEUTRAL PLASMA. Warden, E. S. College Park, MD; Univ. of Maryland (1974). 88p. University Microfilms Order No. 75-7374.

Thesis (Ph. D.).

The radial density distribution of a nonneutral, electron plasma was measured experimentally. The plasma is confined in a pulsed magnetic mirror field, which adiabatically heats the electron plasma to mildly relativistic energies. The measurements of density were based on the visible and near ultraviolet light emitted from collisions of the electrons with the background gas. To obtain suitable light intensity a puff of neutral gas atoms was injected into the electron cloud; however, this method did not give a reliable measure of plasma density. Further measurements made using single photon counting techniques, both at a pressure of 10^{-6} torr of helium gas and at base pressures near 10^{-9} torr, produced reliable data. These data showed that the electron distribution was not hollow as previously supposed. This is consistent with the movement of electrons across magnetic field surfaces, during the initial gun pulse, caused by space charge effects. Furthermore, two bursts of light were found to occur from neutral gas particles that had been liberated by the gun pulse from the walls and ends of the vacuum vessel. The plasma was also found to begin to expand radially while the magnetic field was still increasing. This phenomena occurred concurrently with the growth of what is assumed to be a growing coherent gradient B precession. (Diss. Abstr. Int., B)

13984 EXPERIMENTAL STUDIES OF PLASMA DENSITY IN THE LARGE WISCONSIN TOROIDAL OCTUPOLE. Rudmin, J. W. Madison, WI; Univ. of Wisconsin (1974). 157p. University Microfilms Order No. 75-2479.

Thesis (Ph. D.).

A theoretical study of single particle motion in time-dependent linear and toroidal multipole fields is presented, including a new approach to solving the equations of motion. The effects of magnetic field perturbations upon the topology of the fields is analyzed by means of following the trajectories of the field lines. The field perturbation caused by a hole in a conducting wall is investigated analytically and is compared with experiment. The behavior of the density profile in a time changing multipole field was analyzed, with special emphasis on the smoothing of the profile due to non-zero ion gyroradii. The results of this analysis are compared with experimentally observed ECRH and gun produced plasmas. It was found that delayed plasma production by energetic electrons strongly affects the plasma density in ECRH plasmas. Studies of gun plasmas indicate that plasma transport in some cases may be affected by electrostatic cell structure and possibly by magnetic field perturbations. (Diss. Abstr. Int., B)

13985 NEUTRAL DENSITY DETERMINATION BY SCATTERING OF VACUUM-u.v. RADIATION. Breton, C.; Papoular, R. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 17: No. 5, 309-316(May 1975).

A method was developed and tested, which makes it possible to measure neutral atomic hydrogen densities as low as a few times $10^9 cm^{-3}$ with a spatial resolution of 1 cm. The apparatus involved is simple and reliable and could easily be used on fusion machines. The same apparatus and technique can also be used for the measurement of other particles if they possess transitions in the vacuum uv range (impurities for instance). (auth)

13986 NEGATIVE ION SPECIES IN CO_2-N_2-He DISCHARGES. Prince, J.F.; Garscadden, A. (Aerospace Research Laboratories, Wright-Patterson Air Force Base, Ohio 45433). Appl. Phys. Lett. 27: No. 1, 13-15 (1 July 1975).

The identification of the negative ion species created in a low-pressure CO_2-N_2-He electric discharge has been accomplished using an on-line quadrupole mass spectrometer. In a slow-flow 1-Torr cylindrical (22-mm-i.d.) discharge plasma, the prominent negative ions are NO^-_2, NO^-_3, O^-_2, O^-, and CO^-_3. The changes in relative composition are presented for the current range 0.2–60 mA. (auth)

13987 PROBE FOR THE MEASUREMENT OF MAGNETIC FIELDS WITH SUB-NANOSECOND RESOLUTION. Serov, R.; Richardson, M.C.; Burtyn, P. (Division of Physics, National Research Council of Canada, Ottawa, Canada). Rev. Sci. Instrum. 46: No. 7, 886-888 (July 1975).

A double coil differential magnetic probe has been specifically devised for the measurement of magnetic fields with high temporal and spatial resolution. Having a response time of <1 nsec, a sensitivity of 0.3 V nsec G^{-1}, and high discrimination (>300) to all other types of background interference, it is well suited to the analysis of magnetic fields associated with plasmas produced by ultrashort laser pulses. (auth)

13988 APPARATUS FOR MEASURING RAPIDLY VARYING ELECTRIC FIELDS IN PLASMAS. Mendel, C.W. Jr. (Sandia Laboratories, Albuquerque, New Mexico 87115). Rev. Sci. Instrum. 46: No. 7, 847-850 (July 1975).

A system is described which can measure plasma electric fields on nanosecond time and submillimeter distance scales. The measurement is made by observing the time dependent deflection of a 10^{-7} A beam of 22 keV He^+ ions. The measurement does not perturb the plasma. (auth)

13989 DIFFUSION REGIME FOR ELECTROSTATIC PROBES AS SINGULAR-PERTURBATION PROBLEM. Chekmarev, I.B. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Tech. Phys. 19: No. 10, 1287-1289 (Apr 1975).

Singular perturbation theory is used to analyze a flat electrostatic probe in a weakly ionized collisional plasma in a uniform external magnetic field parallel to the surface of the probe. The volage—current characteristic is obtained in analytic form in the zeroth approximation. Higher approximations are discussed. (auth)

13990 HIGH-FREQUENCY MODULATION OF ATOMIC BEAMS FOR PLASMA DIAGNOSTICS. Demchenko, P.A.; Krupnik, L.I.; Leontovich, K.A.; Lyangner, E.S. Sov. Phys.—Tech. Phys. 19: No. 10, 1362-1366 (Apr 1975).

A beam of atomic particles with an energy of $\sim 10^4$ modulated at a frequency $\sim 10^6$ Hz is used to probe dense plasmas ($nL \sim 10^{14} - 10^{15}$ cm^{-2}) characterized by high ultraviolet emission. A data-taking system has been developed and tested which provides measurements with high time resolution ($\tau \sim 10^{-6}$ sec) against a high-level background. The signal-to-noise ratio is 10^4. Comparison of the results of plasma density measurements ($nL < 10^{15}$ cm^{-2}) using modulated probe beams with data obtained by other means yield good agreement. Certain conclusions regarding the potential usefulness of particle corpuscular diagnostics using modulated beams are presented. (auth)

13991 PLASMA DIAGNOSTICS BY THE SCHLIEREN METHOD IN THE SUBMILLIMETER WAVELENGTH RANGE. Petrov, G.D.; Samarskii, P.A. (All-Union Scientific-Research Institute for Physico-technical and Radio Engineering Measurements, Mendeleevo). Sov. J. Quantum Electron. 4: No. 12, 1455-1456 (June 1975).

The Schlieren method and an HCN laser ($\lambda = 337$ μ) were used in the determination of the spatial distribution of the electron density N_e in the plasma of a carbon arc, whose jet was in the form of an elliptic cylinder. The maximum and average values of N_e in the central plane were 3×10^{14} and $(0.4–1.0) \times 10^{14}$ cm^{-3}, respectively. (auth)

13992 MEASUREMENT OF PLASMA ELECTRON TEMPERATURE WITH A SINUSOIDAL PROBE POTENTIAL. Kanaev, B.I.; Piterskii, V.V.; Yushmanov, E.E. Sov. Phys.—Tech. Phys. 19: No. 11, 1421-1423 (May 1975).

A method for measuring the electron temperature which does not require the recording of the voltage-current characteristics is described. The method exploits the rectifying properties of the probe; these cause a shift of the floating potential of the probe when an rf voltage is applied to it. The output signal from the probe reflects the electron temperature directly, so that this temperature can be monitored continuously during one-shot processes. Another advantage of this method is its insensitivity to changes in plasma properties other than T_e. In most cases a magnetic field does not hinder measurements. The method has been used successfully in experiments on the confinement of hot plasmas in magnetic traps. (auth)

Plasma Kinetics (General)

13993 (AED-CONF-75-043-015) TEMPERATURE IN A ROTATING PLASMA DISK. Marlier, S. F. (Technische Univ. Muenchen (F. R. Germany). Elektrophysikalisches Inst.). 1975. 8p. (In German). INIS.

From spring meeting of the Fachausschuesse Kurzzeitphysik and Plasma- und Gasentladungsphysik of the DPG; Duesseldorf, F. R. Germany (4 Mar 1975).

8 figs.

The paper describes experimental and theoretical investigations in an argon arc to determine the axial and radial temperature distribution in a plasma. (GE)

13994 (FRNC-TH-521) SPECTRAL AND ASYMPTOTIC STUDY OF THE MULTIPLICATION TRANSPORT EQUATION OF ELECTRONS. Lacaze, J. (Toulouse-3 Univ., 31 (France)). 1974. 37p. (In French). INIS.

A first collision equation is established to study the electron population fluctuations in an avalanche. The mean value of the random variable N_t (the total electron occupation) which is submitted to an adjoint form of the electron multiplicative transport equation is investigated: a spectral and asymptotic study of this transport equation is made. This work constitutes a first step in the convergence study of the reduced occupation variable of the electrons. These results should lead to a new method of experimental diagnostic for the microscopic evaluation of the electron motion in a weakly ionized gas. (FR)

13995 (TRITA-EPP-74-23) PLASMA EQUILIBRIUM IN EXTERNAL RING SYSTEMS. Hellsten, T. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Dec 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

The equilibrium of a plasma situated in the space between four straight conductors was investigated by means of a numerical method. The magnetic field which confines the plasma is produced partly by parallel currents flowing in the conductors, partly by a plasma current flowing in the opposite direction. The calculations show that there exist equilibrium states which are stable with respect to compressive and expansive perturbations. The geometrical shape of the plasma cross section depends mainly on the relative thickness of the plasma body as compared to the conductor separation distance, on the ratio between the plasma current and the conductor currents, and on the distribution of the current density in the plasma. (auth)

13996 THIRD INTERNATIONAL CONFERENCE ON GAS DISCHARGES, LONDON, ENGLAND, SEPTEMBER 9–12, 1974. IEE Conference Publication No. 118. London; Institute of Electrical Engineers (1974). 652p. Pounds 18.30.

141 papers are presented of which 10 are within NSA scope and for which separate abstracts have been prepared. (UK)

For abstracts of individual papers see: 13976, 13977, 13997–14002, 14029, and 14118.

13997 INFLUENCE OF THE IONS' PRELIMINARY ACCELERATION ON THE EXTRACTION OF THE IONIC BEAM FROM THE PENNING DISCHARGE PLASMA SURFACE. Grigoryan, V. G.; Guvarev, I. A.; Latishev, L. A.; Obukhov, V. A. (Moscow Aviation Inst.). pp 145-148 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

Accelerators with a gaseous discharge ion source and electrostatic extraction system are widely used to obtain accelerated ion beams in the range of 0.5 to 5 KeV. The extraction system of such an accelerator, where preliminary ion acceleration in the direction of the screening grid of the ion extraction system is carried out in the ion source, is discussed. The extraction parameters of the ion beam from the Penning discharge plasma surface are calculated with respect to the preliminary ion acceleration, having considered the assignment of boundary conditions and the effect of the sheath density. A gaseous discharge source with preliminary acceleration has been developed and experiments carried out to check the theory. (UK)

13998 CALCULATION OF FIELD DISTORTION IN NON-UNIFORM FIELD GAPS PRODUCED BY IRRADIATION. Matthews, J. E. (Strathclyce Univ., Glasgow). pp 197-200 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

An irradiation induced space charge effect caused by the separation of positive and negative charges during the rise time of applied voltage in spark gaps is investigated. The results indicate that the effect of charge separation on the electric field strength on the axis of a spark gap are negligible in comparison with the applied field. (UK)

13999 HIGH FREQUENCY PLASMA OSCILLATIONS IN A CROSS-FIELD DISCHARGE (E-H). Bishaev, A. M.; Gerasimov, V. P.; Kim, V.; Latishev, L. A.; Shishkin, G. G. (Moscow Aviation Inst.). pp 243-246 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

The characteristics of the hf (10 to 1000 MHz) oscillations in a Hall E-H accelerator have been measured experimentally. The spatial distributions of the hf oscillation characteristics are compared with the spatial distribution of the main plasma parameters. (UK)

14000 SPACE PLASMA SIMULATOR AND ITS APPLICATION TO PLASMA WAVE STUDIES. Itoh, T. (Tokyo Univ.). pp 271-274 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

A space plasma simulator is described which was designed as a test facility of rocket and satellite borne plasma probes. The characteristics of the plasma produced by the specially designed plasma sources are given. The plasma simulator has also proved useful for fundamental researches of low density plasmas, especially for studies of electrostatic plasma waves. Some experimental results, fully reported elsewhere, are summarized. (UK)

14001 DEPOSITION OF ATOMS SPUTTERED IN A PULSED DISCHARGE. Mase, H.; Tanabe, T. (Ibaraki Univ., Hitachi, Japan). pp 334-337 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

An investigation of the process of deposition of Cu film, sputtered in a pulsed discharge in Ar, over the pressure range 0.45 to 1.1 Torr where diffusion is predominate, with a cathode-collector distance of 2.0 and 1.5 cm, is reported. (UK)

14002 ARC-HEATER FOR HIGH-ENTHALPY PLASMA FLOWS. Huegel, H. (Deutsche Forschung- und Versuchsanstalt fuer Luft- und Raumfahrt e.v., Stuttgart). pp 549-553 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

An arc-heater, producing high enthalpy flows, is described, which was developed in order to study the self-magnetic effect as a means for continuous plasma acceleration. Experimental results, demonstrating typical operating and performance data rather than the physical properties of the plasma jets produced by the arc-heater, are discussed. Possible applications of this device are considered. (UK)

14003 DETERMINATION OF ELECTRON ENERGY DISTRIBUTIONS IN DISCHARGES WITH SECONDARY PLASMA PARTS. Berger, E.; Heisen, A. (Univ., Muenchen, Ger.). J. Phys., D (London); 8: No. 6, 629-639(21 Apr 1975).

It is shown that on the measurement of electron energy distributions with Langmuir probes, in low pressure discharges, distortions appear if there exist secondary discharge parts such as anode glow or a positive column between the plasma surrounding the probe and the reference electrode. For the case of a current-independent resistance R_p of these discharge parts it is possible to evaluate a factor $[(R_s + R_p)/R_s]^3$ to correct the relation between the current amplitude of the first harmonic and the second derivative: $I_{2\omega}(U + U_0 \sin\omega t) = (1/4)\, U_0^2\, [(R_s + R_p)/R_s]^3\, (d^2I/dU^2) \cos 2\omega t$ where U_0 is the amplitude of the applied fundamental wave, and R_s is the resistence of the probe-plasma transition. Because of the difficulty in correcting the measured curves point by point, a control circuit has been developed to correct the second derivative automatically. In order to show the efficiency of the layout quantitative measurements in the negative glow and Faraday dark space are presented. (auth)

14004 ELEMENTARY PROCESS KINETICS IN A PLASMA OF INERT GASES, MOLECULES, AND ALKALI METAL VAPORS (REVIEW). Mnatsakanyan, A.K. (Academy of Sciences of the USSR). High Temp. 12: No. 4, 745-762 (Mar 1975).

Experimental and theoretical data on cross sections of the following processes are considered: vibrational excitation of molecules by electron impact, quenching of resonance levels of alkali metal atoms by collisions with molecules, and molecular vibrational relaxation by collisions with heavy particles. The kinetics of step-like ionization, the balance of

molecular vibrational energy and electron energy, and some other plasma effects are discussed. (auth)

14005 MEASUREMENT OF THE M NUMBER IN PLASMA JETS. Kozlov, N.P.; Leskov, L.V.; Protasov, Y.S.; Khvesyuk, V.I.; Yaminskii, V.V. High Temp. 12: No. 4, 609-615 (Mar 1975).

The M number has been experimentally determined in supersonic self-compressing plasma streams of the plasma-focus type produced by pulsed erosion plasma accelerators. The M number has been determined using Mach reflection from a plane plate with a sharp leading edge placed at a zero attack angle at different distances from the slits of the accelerators. A practical probe method is proposed for measuring the M number in plasma streams. (auth)

14006 STUDIES OF SEPARATION DISTANCES IN A MAGNETICALLY DRIVEN SHOCK TUBE WITH PARALLEL-PLATE ELECTRODES. Chang, C. T. (Danish Atomic Energy Commission, Risoe. Research Establishment). Z. Naturforsch., A; 29: No. 12, 1838-1845(Dec 1974).

The separation distances between the pressure front, the luminous front, the ionization and the current front in a magnetically driven shock tube were investigated under discharge conditions of constant voltage and variable pressures. In order to achieve a steady-state, one-dimensional flow-parallel-plate electrodes and a constant voltage energy source were chosen. Conventional magnetic probe and piezo-electric probes were used as diagnostic tools. These were supplemented by Schlieren and holographic interferograms. Experimental results show that the observed lack of separation at low discharge pressures can be attributed to the diffusive nature of the driving current. Due to the presence of anomalous diffusion, its cause cannot be entirely explained by present theories. (GE)

14007 ABSOLUTE MEASUREMENT OF POWER TRANSFER TO A DEUTERIUM PLASMA NEAR THE LOWER HYBRID RESONANCE. Lammers, B.; Oberlack, U.; Schlueter, H. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik 2). Z. Naturforsch., A; 30: No. 2, 204-211(Feb 1975). (In German).

The power transfer to a deuterium plasma generated by a high frequency discharge near the lower hybrid resonance is investigated in the range of several hundred watts. The results are compared with linear theories. Reasonable agreement is found between measurements and the linear theory of a bounded plasma as far as the wings of the resonance are concerned. But the dominant radial modes predicted by theory are not observed. Introduction of an empirical effective collision frequency $\nu = 0.2\,\omega_{pe}$, however, results in good agreement between measurements and theory in the domain of these radial modes. (GE)

14008 NONLINEAR IONIZATION WAVES AND THEIR PARTICLE-LIKE PROPERTIES. Grabec, I.; Mozina, J. (Univ., Ljubljana, Yugoslavia). Beitr. Plasmaphys.; 14: No. 1, 1-15 (1974).

A nonlinear equation of ionization waves is derived and numerically solved under a spatially periodic initial condition. The solutions reproduce the essential features of striations in a positive column of an inert gas at a constant high discharge current and a pressure of the order of 1 torr. The calculated distributions of charged particles concentration indicate that high amplitude striations can be treated as particles. (auth)

14009 RELATIVISTIC BRILLOUIN FLOW IN THE HIGH ν/γ DIODE. Creedon, J.M. (Physics International Company, San Leandro, California 94577). J. Appl. Phys. 46: No. 7, 2946-2955 (July 1975).

Relativistic Brillouin solutions have been derived for electron flow in crossed electric and magnetic fields. The application of these solutions to the high ν/γ diode is discussed and an approximate analytical expression for the anode current is derived. Measurements of diode current are compared to the theoretical and empirical expressions for diode current which have been developed. (auth)

14010 SPECTRAL NARROWING OF A SINGLE-MODE BEAM OSCILLATOR. Buts, V.A.; Kurilko, V.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 19: No. 11, 1494-1495 (May 1975).

The correlational characteristics of the signals of a single-mode beam generator resulting from fluctuations in the beam distribution function (at the input to the interaction regions) are studied. The intensity of the fluctuations depends on the stationary signal level. It is also shown that preliminary modulation of the beam at the system input, at the frequency of the generated signal, causes a marked reduction in spectral width. (auth)

14011 INFRARED RADIATION OF A THERMAL XENON PLASMA. Konkov, A.A.; Vorontsov, A.V. Opt. Spectrosc. (USSR) 38: No. 2, 138-140 (Feb 1975).

An experimental investigation has been made into the radiation of a thermal xenon plasma at temperatures of 6000–10,000 °K, pressures of 1–10 atm, and wavelengths of 2–6 μm. It has been found that in the indicated range of parameters the radiation due to deceleration of electrons by xenon atoms can be described by an equation that relates the absorption cross section to the elastic scattering cross section for $\bar{\sigma}'_{Xe} = 1.7 \times 10^{-15}$ cm^2. (auth)

14012 INTERACTIONS OF RELATIVISTIC ELECTRON BEAMS WITH HIGH ATOMIC-NUMBER PLASMAS. Mosher, D. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 18: No. 7, 846-857 (July 1975).

A relativistically correct Fokker–Planck analysis is used to develop fluid equations which model the interaction of relativistic electron beams with high atomic-number plasmas. The derived collision terms can be used to describe scattering and energy loss in materials ranging from the solid to high-temperature plasma forms. The full set of equations discussed can be used to study electron-beam-initiated pellet fusion in a completely self-consistent fashion. Specifically, the model is applicable to study of beam pinching in plasma-filled diodes, the interaction of focused beams with target plasmas, and the transport of high ν/γ beams in high atomic-number plasmas. Although the general equations are amenable to solutions only by computational techniques, analytic solutions describing the time-dependent, collisional interaction of a beam in an infinite plasma and the one-dimensional equilibrium of a beam in a plasma with applied electric field have been obtained. (auth)

Plasma Kinetics (Experimental)

14013 (BNL-tr-603) SPECTROSCOPIC DETERMINATION OF ELECTRON CONCENTRATION IN THE ARC OF A MONO-PLASMATRON ION SOURCE. Abroyan, M. A.; Kagan, Yu. M.; Kolokolov, N. B.; Lavrov, B. P. 1974. Translation by S. J. Amoretty of NIIEFA-D-0221. 15p. Dep. NTIS $4.00.

Investigation of the properties of a contracted arc discharge at reduced pressure is of great importance in view of the wide use of such discharges in ion plasma sources. Results are reported of investigating a monoplasmatron arc discharge in hydrogen. The measurements were conducted in the pressure range of 0.02 to 0.2 torr and current ranging from 0.1 to 0.55 A. (MOW)

14014 (UCID-16789) MEASUREMENTS OF ELECTRICALLY EXPLODED TUBES. Shearer, J. W.; Hartman, C. W.; Munger, R. H.; Gullickson, R. L.; Trimble, D. O.; Cheng, D. Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 May 1975. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

The dynamics of electrically exploded tubes were investigated, principally by means of current measurements and flash x-ray pictures. The pinch effect was observed on the tube motion. Pileup of the imploding tube metal was seen on axis. An approximate analytical model can be roughly fitted to the data, but a more complete fit can be obtained with detailed numerical codes. Application of the results to the planning of future gas-embedded Z-pinch experiments is discussed. (auth)

14015 ELECTRON TEMPERATURE RELAXATION RATES IN FLOWING AFTERGLOW PLASMAS CONTAINING MOLECULAR NITROGEN AND OXYGEN. Smith, D.; Dean, A. G. (Univ. of Birmingham, Eng.). J. Phys., B (London); 8: No. 6, 997-1008 (21 Apr 1975).

Measurements have been made, at gas temperatures of 300°K, of electron temperature, T_e, relaxation rates ($2000°K \geq T_e \geq 350°K$) in pulsed flowing afterglow plasmas of pure argon and argon-nitrogen and argon-oxygen mixtures at several partial pressures, P_δ, in each gas. The molecular gases were titrated into the flowing plasma remote from the discharge plasma source thus avoiding any internal excitation of the molecules. T_e was measured to a high degree of spatial (and hence temporal) resolution using a Langmuir probe. In argon $(1/P_\delta)(dT_e/dt)_{Ar}$ was found to be independent of both P_δ and T_e, and from this parameter momentum transfer cross sections were derived, which are in good agreement with previous data. For nitrogen and oxygen the situation was more complex, $(1/P_\delta)(dT_e/dt)_M$ being dependent upon T_e. From this parameter, values of G, the fraction of energy transferred per collision, were deduced using previously published results for momentum transfer cross sections. These G values show a marked variation with T_e as expected and as such are interpreted in terms of energy transfer to rotational states of the molecules. Assuming the temperature independent classical contribution to G due to elastic collisions, $G_M (= 2m/M)$, the separate components due to rotational excitation G_{rot}, are deduced, which indicates that G_{rot}/G_M is as great as 30 at the lowest T_e studied, in both gases. The G values over the complete T_e range are less than theoretically predicted in the case of nitrogen, but greater than predicted in the case of oxygen. (auth)

14016 LOWERING OF THE POPULATIONS OF EXCITED HYDROGEN AND HELIUM ATOMS IN PLASMAS IRRADIATED BY A LASER BEAM. Drawin, H. W. (CEN, Fontenay-aux-Roses,

France); Emard, F.; Dubreuil, B.; Chapelle, J. Beitr. Plasmaphys.; 14: No. 4, 103-120(1974).

From Europhysics Study Conference on Atomic and Molecular Physics of Ionized Gases; Versailles, France (3 Apr 1973).

The populations of excited hydrogen and helium atoms in non-lte plasmas were calculated for two different physical situations, namely (1) no external radiation field present, and (2) strong superposed radiation originating from a CO_2, ruby or argon ion laser. The radiation field intervenes in the collisional-radiative model via two new terms: Photoionization and stimulated recombination induced by the laser radiation field. The solutions of the rate equations yield a lowering of the populations when a plasma is irradiated by a laser beam. The lowering is different for cold recombining and hot diffusion-dominated plasmas. At high radiation densities a saturation effect occurs, since the photoionization rate becomes equal to the rate of stimulated recombination. Measurements of the populations of excited H and He atoms in a glow discharge irradiated by a CO_2 laser beam of power density 10^5 W/cm^2 are in broad agreement with the theoretical predictions. (auth)

14017 BOUNDARY LAYER IN AN ARGON PLASMA UNDER A REDUCED PRESSURE: DENSITY OF POPULATION OF THE METASTABLE AND RESONANT STATES AND ATOMIC TEMPERATURES. Menard, J.-F.; Terrier, Marc; Vervisch, Pierre; Helbert, J.-M. (Rouen Univ., 76- Mont-Saint-Aignan (France). Lab. de Thermodynamique). Compt. Rend., Ser. A, B; 279: No. 26, 645-648(23 Dec 1974). (In French).

The use of an interferometric Fabry-Perot apparatus in absorption spectrometry allowed the profiles of the density population of the metastable and resonant states to be determined above a plane wall in the flow of a vacuum arc plasma (1mm Hg). The translation temperature of the atoms is also deduced from the absorption profile. (FR)

14018 ACCELERATION OF PLASMA ELECTRONS IN STRONG ELECTRIC FIELDS. Al'bikov, Z.A.; Ivanov M.I.; Kazacha, V.I.; Kozlov, O.V.; Rusanov, V.D.; Sobolev, S.S. (Submitted April 10, 1974). Sov. Phys.–Tech. Phys. 19: No. 11, 1498-1499 (May 1975).

Employing a copper toroidal chamber, we have studied the acceleration of plama electrons exposed to strong electric fields. The time dependence of the resultant current is analyzed. (AIP)

14019 MEASUREMENT OF ION DENSITY BY THE DISPERSION RELATION FOR AN ION-BEAM PLASMA. Gabovich, M.D.; Katsubo, L.P.; Soloshenko, I.A. (Physics Institute, Academy of Sciences of the USSR, Kiev). Sov. Phys.–Tech. Phys. 19: No. 11, 1412-1413 (May 1975).

An experimental study has been made of the dispersion properties of transverse ion modes excited by a fast ion beam which also ionizes the background gas. In accordance with theory, for $k^2d_e^2 \ll 1$ (d_e is the electron Debye radius) the frequency $\omega_k = kc_s$, where c_s is the ion acoustic velocity; in the opposite limit ($k^2d_e^2 \gg 1$), $\omega_k \simeq \omega_{pi}$, where ω_{pi} is the ion plasma frequency. The ion plasma modes have the growth rate ($\omega \simeq \omega_{pi}$). This result, and the fact that the oscillations are localized, ($k^2d_e^2 \gg 1$), means that the radial density profiles of the slow ions can be measured. (auth)

14020 FREE EXPANSION OF PLASMA JETS. Demchenko, P.A.; Krupnik, L.I.; Lyangner, E.S. Sov. Phys.–Tech. Phys. 19: No. 11, 1426-1428 (May 1975).

An experimental study is reported of the free expansion in vacuum of plasma jets with densities $n \sim 10^{14}$ cm^{-3} and velocities $v \sim (0.5-1) \cdot 10^7$ cm/sec. The radial distribution of the density and the density distribution along the flow axis are studied. The electron temperature is measured. The results are compared with existing theoretical models for the expansion of plasmas and molecular fluxes. The possibility of finding the ion temperature is discussed. (auth)

14021 TEMPORAL EVOLUTION OF THE ELECTRON DENSITY IN HIGH-PRESSURE ELECTRON-BEAM-EXCITED XENON PLASMAS. Zamir, E.; Werner, C.W.; Lapatovich, W.P.; George, E.V. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Appl. Phys. Lett. 27: No. 2, 56-58 (15 July 1975).

Measurements of the free-free absorption coefficient in high-pressure (50-400 psia) e-beam-excited rare-gas plasmas have been used to deduce the temporal evolution of electron density in these systems. The measurements were carried out using a focused CO_2 laser beam passing through the excited region of the plasma. Comparison of theory and experiment in the early afterglow, where Penning ionization of excimers dominates the electron production, yields a room-temperature rate coefficient of 8×10^{-11} cm^3/sec for this process in xenon. (auth)

Plasma Kinetics (Theoretical)

14022 (AD/A-002383) RAY EMISSIVITY DUE TO GYRO-SYNCHROTRON RADIATION IN MAGNETOACTIVE PLASMA. Ko, H. C. (Ohio State Univ. Research Foundation, Columbus (USA)). 4 Oct 1974. Contract F19628-73-C-0004. 11p. (AFCRL-TR-74-0507). NTIS $3.25.

It is shown that the ray emissivity due to gyro-synchrotron radiation in magnetoactive plasma can be obtained from the wave-normal emissivity without explicitly calculating the electric and magnetic fields of the radiating electron. Errors in the ray emissivity formula in the current literature are discussed. (GRA)

14023 (AED-CONF-75-043-009) MONTE-CARLO METHOD INVESTIGATIONS OF MICROFIELDS WITH HIGH NUMBERS OF PARTICLES UNDER HOLTSMARK'S CONDITIONS. Kreitz, N. (Duesseldorf F. R. Germany). 1975. 5p. (In German). INIS.

From spring meeting of the Fachausschuesse Kurzzeitphysik and Plasma- und Gasentladungsphysik of the DPG; Duesseldorf, F. R. Germany (4 Mar 1975).

With abstract.

With the aim to include in numerical micro field experiments higher particle numbers N at given computer capacity the appearing problems are discussed and computer programs are developed. The experiments with N up to 10^6 show under Holtsmark's conditions—that is static case without coulomb interaction—a beginning reduction of the field contribution of the charge nearest to the point under consideration and an increasing of the collective distant field contribution. This behaviour emerges in the region of the investigated particle numbers in a change of probability density moments for the microfield proportional to N. (auth)

14024 (COO-2081-25) QUASILINEAR DIFFUSION IN INHOMOGENEOUS PLASMAS. Hooley, D. L. (Colorado Univ., Boulder (USA)). May 1975. Contract AT(11-1)-2081. 16p. Dep. NTIS $4.00.

The problem of inhomogeneous diffusion in a plasma is considered with emphasis on its possible application to relativistic electron beams. A one-dimensional model with a background electrostatic field is used to illustrate the basic approach, which is then extended to a two-dimensional plasma with a background magnetic field. Only preliminary results are available. (auth)

14025 (JUL-1138-PP) DIFFUSION OF A COLLISIONAL PLASMA WITH ELLIPTIC CROSS SECTION IN AXIAL SYMMETRIC MAGNETIC FIELDS. Nicolai, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Plasmaphysik). Nov 1974. 31p. (In German). INIS.

19 figs.; 16 refs.

Neglecting the viscosity, the pressure anistropy and inertia, the Pfirsch-Schlueter factor, the density profile and particle confinement time of a collisional toroidal plasma with an elliptical cross section are calculated. Magnetic fields are considered with flux areas, which have confocal or similar ellipses as cross sectional shape. The plasma pressure is assumed as small compared to the magnetic field pressure (low β-approximation). It can be seen that the Pfirsch-Schlueter factor decreases with standing torus with growing deformation and increases with lying torus. For the diffusion equation, the independence of the starting values asymptotic solution is calculated. It can be seen that confinement time with standing torus increases and with lying torus decreases with growing deformation. The results for both model fields qualitatively agree. The same electron and ion temperatures and stationary state of the temperature distribution is assumed for the calculations. The applicability of the theory for the special conditions in TENQ is discussed and numerical examples are given. (auth)

14026 (KIYI-74-21) ON THE SYMMETRY OF HIGH FREQUENCY MOTIONS OF PLASMA. Taranov, V. B. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1974. 6p. INIS.

Equations of Vlasov–Maxwell describing the high-frequency movement of a collision-free plasma were investigated by a group method. From investigations of the symmetry of the model it was possible to find new, exact solutions of the equations. (SJR)

14027 BREMSSTRAHLUNG IN A PLASMA UNDER THE INFLUENCE OF A STRONG MAGNETIC FIELD. Virtamo, J.; Jauho, P. (Tech. Research Centre, Helsinki). Nuovo Cim.; 26B: No. 2, 537-558(11 Apr 1975).

The bremsstrahlung emission rate of soft photons in a non-relativistic plasma, immersed in a magnetic field, is calculated. Attention is focused on the strong-field case, whence only transitions between Landau ground levels are to be included. The results of Canuto and Chiu are generalized to an arbitrary direction of photon propagation. One finds that emission in a general direction is far more intense than that in the special cases dealt with by Canuto and Chiu; the transition responsible for this strong emission differs from that playing the dominant role in those special cases. For the calculation, the wave modes in the plasma are quantized as devised by Harris. The technique of ladder operators is employed to derive the electron wave function, and the pertinent matrix elements. (auth)

14028 ELLIPTICAL TOROIDAL GEOMETRY: A GEOMETRIC TRANSPORT CORRECTION. Pomraning, G. C. (Science Applications, Inc., La Jolla, CA). Nucl. Sci. Eng.; 57: No. 3, 188-195(Jul 1975).

The transport and diffusion equations are developed in toroidal geometry, with the torus exhibiting a general elliptical cross section. These equations are presented in two different coordinate systems, each of which has its own advantage. It is shown that the elliptical toroidal diffusion equation can be cast into the standard r--THETA cylindrical equation by appropriately redefining the interaction cross sections and external source. This suggests a "geometric transport correction"--a geometric modification to the r--THETA cylindrical transport equation which accounts for both the toroidal and elliptical character of the system. (auth)

14029 NEGATIVE ELECTRODE SHEATH WITH IONIZING COLLISIONS. Rosa, R. (Junta de Energia Nuclear, Sacavem, Portugal). pp 338-342 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

A comparatively simple model of a collisional plasma sheath, ionization included, in contact with a negative electrode, is proposed. Ionized gases at pressures of 0.1 Torr upwards and with a bias of a few tens to a few hundred volts, are considered. A quantity called the sheath current gain or multiplication factor (g) is defined mathematically. This is the factor by which the ion current leaving the plasma is multiplied when passing across the sheath. (UK)

14030 STABILITY OF A CLASS OF BIFURCATED, MAGNETOHYDRODYNAMIC FREE BOUNDARY EQUILIBRIA. Kappraff, J. M. New York; New York Univ. (1974). 60p. University Microfilms Order No. 75-9668.

Thesis (Ph. D.).

The ideal magnetohydrodynamic free boundary model is employed to study the bifurcation of a family of helically symmetric equilibria. The equilibria are intended to approximate the Stellarator experiment with low plasma pressure and L equals 2 helical symmetry. The study is carried out in a plasma column of finite length, surrounded by a vacuum region, all enclosed within an outer conducting wall. The straight helical equilibria are obtained by expansion in two parameters, c and epsilon, the ratio of the helical magnetic field to the theta pinch field, and the product of the helical wavenumber times the plasma column radius, respectively. The distortion of the plasma column from a true cylinder is taken to be small of order c. The column length is chosen to avoid "kink instabilities" for some range of azimuthal wavenumbers, n, for which the theory applies, and the critical beta is obtained. At this beta, a marginally stable state of principally n equals 1 long wavelength mode is determined and serves as the starting point for bifurcation. The stability analysis is based on a determination of the sign of the second variation of the potential energy. Neighboring bifurcated equilibria are found by expanding the fields in another small parameter. The bifurcated equilibria are found to be stable when the conducting wall is within 1.15 plasma column radii of the plasma vacuum interface. This position was not sufficient to stabilize the original equilibrium. (Diss. Abstr. Int., B)

14031 INVARIANT FORM OF THE DIELECTRIC TENSOR OF A WARM PLASMA IN CONSTANT MAGNETIC FIELD. Chen, H. C. (Ohio Univ., Athens). J. Franklin Inst.; 299: No. 4, 287-290(Apr 1975).

The derivation clearly shows the dependence of the tensor on both the directions of the constant magnetic field and the wave vector and can be reduced to the known matrix representation when a particular Cartesian coordinate system is introduced. The derivation is given. (MOW)

14032 DYNAMICAL CORRELATIONS IN THE ONE-COMPONENT PLASMA. Abramo, M. C.; Parrinello, M. (Univ., Messian, Italy). Lett. Nuovo Cim.; 12: No. 17, 667-675(26 Apr 1975).

The statistical properties of the classical one-component plasma are discussed. Computer simulation data are compared with the predictions of two different models, the mean-field theory of Pathak and Singrol (Phys Rev. A, 2, 2427(1970)) and the viscoelastic model due to Lovesey (J. Phys. C, 4, 3057(1971)). (MOW)

14033 EFFECT OF ELECTRIC FIELD ON NON-IDEAL PLASMA CONDUCTIVITY. Kozlov, N. P.; Protasov, Yu. S. (Moscow Bauman Higher Technical School, Moscow 107005, USSR); Norman, G. E. (Institute of High Temperatures, Moscow 127412, USSR). Phys. Lett., A; 51: No. 8, 493-494(5 May 1975).

An order of magnitude increase in plasma electrical conductivity with increase in electric field up to 10^3 V/cm has been experimentally observed for plasma with $\xi/Z \sim 1$, where ξ is the number of electrons in Debye sphere, $Z = 1-3$ is the stage of ionization. The effect vanishes at $\xi/Z \gtrsim 10$. (auth)

14034 ELECTRON HEATING AND LANDAU DAMPING IN INTENSE LOCALIZED ELECTRIC FIELDS. Bezzerides, B.; DuBois, D.F. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 34: No. 22, 1381-1384 (2 June 1975).

A systematic kinetic-theory treatment of the interaction of electrons and ions with intense high-frequency localized electrostatic fields is formulated. A generalization of the familiar nonlinear Schrödinger equation includes nonlinear Landau-damping effects which prevent soliton collapse. An analytic calculation predicts a heated-electron distribution behaving asymptotically as $\exp(-v/v_0)$ ($v_0 = e\xi_0/4m\omega_0$) and modulated in the region near the localized field to form streamers in phase space. (auth)

14035 NONMONOTONIC POTENTIAL DISTRIBUTION IN THE ELECTRODE REGION. Loshkarev, A.I. Sov. Phys.—Tech. Phys. 19: No. 10, 1308-1311 (Apr 1975).

Low-voltage arcs with a nonmonotonic potential distribution in the electrode sheath are examined. The inclusion of electron and ion scattering is important because it provides correct matching to the neutral plasma. Simple analytic expressions are obtained for the potential drop near the cathode; these agree with the experimental data. The space charge at the minimum potential is fairly small, making it possible to match the solution to the neutral plasma at the minimum. This matching is equivalent to the existence of a solution with fixed striations, which have been observed experimentally in cesium discharges. Moving striations are also discussed. (auth)

14036 PROPAGATION OF AN UNSTABLE SPECTRUM OF PLASMONS IN THE PRESENCE OF RANDOM INHOMOGENEITIES. Coste, J.; Reinisch, G.; Silevitch, M.B.; Montes, C. (Laboratoire de Physique de la Matière Condensée (Laboratoire associé au Centre National de la Recherche Scientifique), Université de Nice, 06100-Nice, France). Phys. Fluids 18: No. 6, 679-691 (June 1975).

A one-dimensional stochastic kinetic equation for the propagation of unstable plasmons (Langmuir modes) in the presence of large scale random spatial fluctuations is presented, within the frame of the WKB approximation, and then solved. Using probabilistic arguments, an effective growth rate is evaluated, which turns out to be much smaller than the plasmon growth rate in the absence of fluctuations. The theory is then applied to the beam-plasma kinetic instability and to the stimulated photon-plasmon interaction. The former case exhibits a shift of the turbulent plasmon spectrum toward larger wavenumbers. The latter case shows a strong reduction in the efficiency of the stimulated process (i.e., much smaller growth rate) and the removal of the strong asymmetry inherent in this problem. (auth)

14037 COMMENTS ON "TOROIDAL EQUILIBRIUM OF CURRENT CARRYING PLASMAS". Infeld, E. (Department of Applied Mathematics and Theoretical Physics, Cambridge, England). Phys. Fluids 18: No. 6, 753-753 (June 1975).

A method for constructing large aspect ratio toroidal equilibrium is shown to be more general than realized by the original author. (auth)

14038 TWO-DIMENSIONAL TURBULENCE IN INVISCID FLUIDS OR GUIDING CENTER PLASMAS. Seyler, C.E. Jr.; Salu, Y.; Montgomery, D.; Knorr, G. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242). Phys. Fluids 18: No. 7, 803-813 (July 1975).

Analytic theory for two-dimensional turbulent equilibria for the inviscid Navier–Stokes equation (or the electrostatic guiding center plasma) is tested numerically. A good fit is demonstrated for the approach to a predicted energy per Fourier mode obtained from the two-temperature canonical ensemble of Kraichnan: $\langle |u(k)|^2 \rangle = (\alpha + \beta k^2)^{-1}$, where k is the wavenumber and α and β are reciprocal energy and enstrophy temperatures. Negative as well as positive temperature regimes are explored. Fluctuations about the mean energy per mode also compare well with theory. In the regime $\alpha < 0$, $\beta > 0$, with the minimum value of $\alpha + \beta k^2$ near zero, contour plots of the stream function reveal macroscopic vortex structures similar to those seen previously in discrete vortex simulations by Joyce and Montgomery. Kraichnan's assertion that thermodynamic limits exist for the negative temperature states is questioned. Eulerian direct interaction equations, which can be used to follow the approach to inviscid equilibrium, are derived. (auth)

14039 ELECTRON THERMAL CONDUCTIVITY IN THE TRAPPED ELECTRON REGIME IN THE FM-1 SPHERATOR. Ejima, S.; Okabayashi, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 18: No. 7, 904-912 (July 1975).

The parametric dependence of electron thermal conductivity was studied in the trapped electron regime by utilizing a localized heating method in a shear stabilizing configuration in the FM-1 spherator. The

electron thermal conductivity $K_\perp$ and the particle diffusion coefficient $D_\perp$ show similar dependence on the shear length, L_s, and the electron temperature $T_e[K_\perp \sim (1/400 \sim 1/800)(L_s/a)\ (kT_e/16eB)]$. The conductivity was larger when the electron temperature gradient was parallel to the density gradient compared with the antiparallel case. The fluctuations associated with the heat flow are compared with the prediction of the trapped electron particle instability. Relevance to tokamak experiments is discussed. (auth)

14040 EFFECTIVE ELECTRICAL CONDUCTIVITY OF A NONUNIFORM PLASMA. Nichols, L.D. (Lewis Research Center, National Aeronautics and Space Administration, Cleveland, Ohio 44135). Phys. Fluids 18: No. 7, 920-921 (July 1975).

A simple nonuniformity model for calculating effective electrical conductivity and Hall parameter is proposed. The model shows that the effective conductivity can be significantly reduced by nonuniformities in the Hall parameter, even if the local conductivity is uniform. (auth)

Plasma Production

Refer also to abstract 13971.

14041 (AD/A-002010) EXPERIMENTAL STUDY OF A LASER SUSTAINED AIR PLASMA. Final Report. Keefer, D. R.; Henriksen, B. B.; Braerman, W. F. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Oct 1974. 15p. (BRL-MR-2416). NTIS $3.25.

An experiment was performed to determine the temperature distribution within a stationary plasma in atmospheric air, produced by a continuously operating CO_2 laser. A peak temperature of 17,000°K was found to exist at a point 1.1 cm ahead of the focal point. The radiation surrounding the hot plasma core was found to consist, primarily, of the first negative system of nitrogen. (GRA)

14042 (AD/A-002943) MODEL FOR THE PRODUCTION AND TRANSPORT OF ENERGETIC PARTICLES IN A LASER PRODUCED PLASMA. Manheimer, W. M.; Klein, H. H. (Naval Research Lab., Washington, D. C. (USA)). Dec 1974. 37p. (NRL-MR-2931). NTIS $3.75.

A model is presented for the production and transport of energetic electrons in a laser-produced plasma. The basic assumption is that the laser deposits its energy in the form of a large amplitude plasma wave. The energy is given to particles as the electrostatic wave propagates outward and damps. Theory and simulations show that the maximum energetic particle velocity is between about five and seven thermal velocities. (GRA)

14043 (AD/A-002956) LASER TARGET MODEL. Colombant, D. G.; Whitney, K. G.; Winsor, N. K.; Davis, J.; Tidman, D. A. (Naval Research Lab., Washington, D. C. (USA)). Dec 1974. 50p. (NRL-MR-2954).

A numerical simulation model is described for the dense hot plasma produced in the interaction of a focused laser pulse with a target of moderate atomic weight. Specific results are given for the line and continuum x-ray emission, together with other parameters of the plasma, for the case of an aluminum target. (GRA)

14044 (COO-2081-26) MAGNETIC INSTABILITY IN LASER PLASMA. Bandurian, P. (Colorado Univ., Boulder (USA)). May 1975. Contract AT(11-1)-2081. 8p. Dep. NTIS $4.00.

The generation of intense dc magnetic fields in laser heated pellet plasmas is discussed. A dispersion relation is derived using a collisionless model. (auth)

14045 (LA-5917-MS) ION TAIL FILLING IN LASER-FUSION TARGETS. Henderson, D. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.00.

Thermonuclear burn begins in laser-fusion targets with the collapse of the imploding fuel shell. At this instant the ion velocity distribution is non-Maxwellian, requiring correction to the commonly used computer simulation codes. This correction is computed and compared with that arising from the loss of fast ions in marginal (rho R less than 0.01 gm cm^{-2}) targets. (auth)

14046 (UCRL-76888) THEORY OF HIGH DENSITY LASER FUSION. Zimmerman, G. B.; Nuckolls, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 May 1975. 40p. Dep. NTIS $4.00.

A basic laser fusion scheme is presented. Some of its subtleties are described and the theoretical difficulties which now appear to be the major obstacles are considered. Interpretations of some recent laser compression experiments are given. (MOW)

14047 MAGNITUDE OF MAGNETIC FIELD GENERATED IN LASER PLASMA. Nastoyashchii, A. F. At. Energ. (USSR); 38: No. 1, 27-28(Jan 1975). (In Russian).

The magnitudes of magnetic fields spontaneously arising in laser plasma and their effects on physical processes in the plasma are assessed. It is shown that in all cases considered there should occur saturation of magnetic field, so that $\omega\tau_e$ cannot significantly exceed a value of the order of unity. (auth)

14048 X—RAY EMISSION SPECTRA FROM HIGH-POWER-LASER-PRODUCED PLASMAS. Ripin, B.H.; Burkhalter, P.G.; Young, F.C.; McMahon, J.M.; Colombant, D.G.; Bodner, S.E.; Whitlock, R.R.; Nagel, D.J.; Johnson, D.J.; Winsor, N.K.; Dozier, C.M.; Bleach, R.D.; Stamper, J.A.; McLean, E.A. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Rev. Lett. 34: No. 21, 1313-1316 (26 May 1975).

Absolute x-ray emission spectra in the range from 1 to 300 keV were measured from CH_2 plasmas produced at the focus of a high-power ($>10^{16}$ W/cm²) 1.06-μm laser. Experimental spectra are compared with hydrodynamic-model predictions. The good agreement indicates that suprathermal electrons are unimportant in the interaction and that self-generated magnetic fields dominate the thermal transport. (auth)

14049 TEMPERATURES AND CLASSICAL REFLECTION IN A HYDRODYNAMIC MODEL OF LASER PLASMA INTERACTION. Cojocaru, E.; Mulser, P. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 17: No. 5, 393-401(May 1975).

The dependence of temperature on the absorbed laser power and on the ion charge in laser-produced plasma was theoretically investigated in plane and spherical geometry for Nd laser intensities from $\phi_0 = 10^{13}$ to 10^{15} W/cm² in rectangular pulse form. The classical reflection coefficient R_z was found to be connected with that of deuterium by the power law $R_z = R_D^{Z^{1/3}}$. It follows that classical reflection cannot be effectively suppressed by seeding targets with high Z materials. (auth)

14050 COMMENTS ON A CONTINUOUS DROPLET SOURCE FOR PLASMA PRODUCTION WITH PULSE LASERS. Lafrance P. (Univ. of Virginia, Charlottesville); Turnbull, R. J.; Foster, C. A.; Woosley, J. P.; Schwenn, U.; Sigel, R. J. Phys., E (London); 8: No. 5, 427-428(May 1975).

Refering to an article by Schwenn and Sigel (J. Phys. E.(London); 7: 715-8 (1974)) in which a continuous droplet source for use with plasma production by lasers was described, it is shown by Lafrance that such a device can be improved by taking into account recent developments in the field of hydrodynamic stability. Turnbull, Foster and Woosley draw attention to some apparent misconceptions in the same article and quote recent work on this type of droplet source. The authors of the original article reply to the comments of Turnbull et al. (UK)

14051 EFFECT OF VARYING PULSE DURATIONS ON THE BREAKDOWN THRESHOLD OF LASER-PRODUCED ARGON PLASMAS. Dewhurst, R. J. (Strathclyde Univ., Glasgow). J. Phys., D (London); 8: No. 6, L80-L83(21 Apr 1975).

The results of gas breakdown in argon are presented where breakdown was caused by picosecond pulses from a Nd : YAG laser. Laser pulsewidths were 30, 55, 140, or 270 ps. Using these data with that previously known, a graph of the variation of breakdown threshold with laser pulse duration leads to confirmation that the predicted behavior of multiphoton ionization processes expected for very short laser pulses is not observed. (auth)

14052 TWO-DIAPHRAGM SHOCK TUBE FOR GENERATING A DENSE HOT PLASMA. Kon'kov, A.A.; Ryazin, A.P.; Sokolov, A.I. (Moscow State University). High Temp. 12: No. 4, 705-708 (Mar 1975).

A description is given of a two-diaphragm shock tube which is used to obtain an air plasma at temperatures up to 15,000°K and pressures up to 150 atm. Results are presented of measured temperatures and pressures behind strong shock waves in air. The measured temperatures and pressures are compared with theory. (auth)

14053 HIGH-POWER THREE-PHASE PLASMA SOURCE. Kiselev, A.A.; Rutberg, F.G. High Temp. 12: No. 4, 722-727 (Mar 1975).

A description is given of a high-power three-phase plasma source for short-term operation up to 50 MW; the working gas may be nitrogen, or a mixture of nitrogen with air, argon, or hydrogen. Results are given from tests. The heat transfer mechanism from the arc to the working body is discussed. (auth)

14054 THERMONUCLEAR FUSION RESEARCH WITH HIGH-POWER LASERS. Johnson, R. R.; Solomon, D. E. Res./Dev.; 26: No. 5, 55-64(May 1975).

A review of laser compression experiments at KMS Fusion is presented. Laser work being carried out is discussed. Measurements of the actual target compression are made from photographs of the bremsstrahlung emission. The observation of neutrons in over 500 neutron-producing shots is discussed. (MOW)

14055 MODEL LASER-COMPRESSION EXPERIMENT. Crow, J. E. (Science Research Council, Chilton, Eng.); Spalding, I. J.; Wesson, J. A. J. Plasma Phys.; 13: 367-376(Apr 1975).

The compression of plasmas by laser beams to produce a significant thermonuclear energy requires very sophisticated experimental techniques and equipment, costing millions of dollars. Comparatively simple techniques are reviewed which should permit a time-resolved demonstration of an isentropic density compression, using low-powered lasers of a type commonly encountered in university research laboratories, and diagnostic equipment of modest cost. Although thermonuclear burn cannot be investigated with such simple apparatus, many aspects of flux-limited thermal transport, light absorption, and end-effects (i.e., intensity assymmetries) could be conveniently and quantitatively investigated. The time-dependent behavior of the proposed experiment was investigated with a one-dimensional computer program, ZIP. While most published calculations have concentrated on what might be possible in the future, when laser technology has so far advanced that significant fusion might be achieved, the emphasis of the present computation was on simplicity, so that a sound understanding of basic phenomena might be obtained economically. (auth)

14056 PLASMA SYNTHESIS BY INJECTION OF AN ELECTRON BEAM THROUGH AN ION SOURCE. Virko, V.F.; Gabovich, M.D.; Kirichenko, G.S.; Nazarenko, O.K. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.–Tech. Phys. 19: No. 11, 1418-1420 (May 1975).

A method is described for producing a plasma by injecting electrons through an ion source. Certain properties of the resulting plasma and its sensitivity to an external transverse magnetic field are studied. (auth)

14057 HYDRODYNAMICS AND BURN OF OPTIMALLY IMPLODED DEUTERIUM-TRITIUM SPHERES. Mason, R.J.; Morse, R.L. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Fluids 18: No. 7, 814-828 (July 1975).

The phenomenology of optimized laser-driven DT sphere implosions leading to efficient thermonuclear burn is reviewed. The optimal laser deposition profile for spheres is heuristically derived. The performance of a 7.5 μg sphere, exposed to its optimal 5.3 kJ pulse, is scrutinized in detail. The timing requirements for efficient central ignition of propagating burn in the sphere are carefully explored. The difficulties stemming from superthermal electron production and thermal flux limitation are discussed. The hydro-burn performance of spheres is characterized as a function of the pulse energy, peak power, time scale, pulse exponent, wavelength, and on the degree of flux limitation. The optimal pulse parameters are determined for spheres with masses ranging from 40 ng to 250 μg, requiring from 50 J to 150 kJ of input energy, and the corresponding optimal performance levels are calculated. Discussion is given to the hydro-burn performance of new structured fusion targets, in which the DT is contained as a gas or frozen as an ice shell inside a high Z pusher-tamper layer. (auth)

Plasma Stability

14058 (CEA-N-1789) SPACE–TIME FORMULATION OF THE NONLINEAR THEORY OF THE PARAMETRIC INSTABILITIES IN A PLASMA. Fortin, X. (CEA Centre d'Etudes de Limeil, 94- Villeneuve-Saint-Georges (France)). 9 Dec 1974. 90p. (In French). INIS.

An infinitesimal response function is defined for a plasma, giving the change in electric potential at a point of the medium when an infinitesimal perturbation of the particle density is set up at another point. This function allows a general study of the main electrical properties of the plasma from the microscopic viewpoint, showing the plasma response to an external excitation and the resulting parametric effects: propagation, attenuation or growth. An equation relates the wave intensity to the noise source responsible for the phenomenon. The calculation is carried out for a nonhomogeneous plasma within the scope of an approximation similar to the WKB approximation. In addition the calculation is conducted in the weak turbulence approximation: only second-order terms with respect to the wave intensity are adopted, i.e., the nonlinear LANDAU damping terms and the mode coupling terms. The formulation is applied to plasmon-phonon decomposition instability. The various cases where instability appears are studied and the thresholds and growth rates are given for each. A study of the intensity of the waves obtained is also proposed. (FR)

14059 (COO-2081-19(Rev.)) NONLINEAR EFFECTS IN MIRROR MACHINES. Aamodt, R. E. (Colorado Univ., Boulder (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1975. 21p. Dep. NTIS $4.25.

The Rosenbluth-Post convective instability in mirrors is discussed. A brief theoretical discussion of the saturation of absolute modes is given. The containment properties of mirrors in the presence of ion cyclotron waves are discussed. (MOW)

14060 (KIYI-74-23) ON QUASI-LINEAR RELAXATION OF THE PARAMETRIC DECAY INSTABILITY OF THE MAGNETIZED PLASMA. Pasechnik, L. L.; Semenyuk, V. F. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1974. 9p. (In Russian). INIS.

Experimental studies were carried out of the velocity distribution function of fast electrons and of the time evolution of the increment of low-frequency oscillations on exciting a parametric decay instability in a plasma. The results of the study are compared with theory, which takes into account the resonance interaction of electrons with the electric field of rising, high-frequency oscillations. The good agreement of the experimental data with the conclusions of theory indicates that the role of the mechanism pointed out above is substantial in stabilizing the parametric decay instability. (SJR)

14061 (MATT-1141) ION-STREAMING INSTABILITIES: ELECTROMAGNETIC AND ELECTROSTATIC. Perkins, F. W. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Jun 1975. Contract AT(11-1)-3073. 38p. Dep. NTIS $5.00.

Electromagnetic effects are shown to reduce the threshold velocity (relative to electrostatic calculation) for ion-beam instabilities in plasmas where the beam velocity, taken parallel to the magnetic field, becomes a modest fraction of the Alfven velocity. The most unstable mode occurs for frequencies in the ion-cyclotron frequency range and is caused by an interaction of the beam with a type of electromagnetic ion-cyclotron wave. Applications of the theory range from basic research experiments, to collisionless shocks and two-component thermonuclear burning devices. (auth)

14062 THEORY OF MICROWAVE EMISSION BY VELOCITY-SPACE INSTABILITIES OF AN INTENSE RELATIVISTIC ELECTRON BEAM. Ott, E.; Manheimer, W. M. (Naval Research Lab., Washington, DC). IEEE Trans. Plasma Sci.; PS-3: No. 1, 1-5(Mar 1975).

The stability of waveguide modes in a waveguide along which is propagated an unneutralized, intense beam of relativistic electrons guided by an applied axial magnetic field is considered. It is found that the waveguide mode can interact unstably with the beam by resonating with the Doppler shifted cyclotron frequency of the beam. This instability appears to be the mechanism by which microwaves are produced in some recent experiments which are discussed. (auth)

14063 RAYLEIGH–TAYLOR INSTABILITY OF A VISCOUS PLASMA IN THE PRESENCE OF HALL CURRENT. Abani, K. (Univ. of Jodhpur, India); Srivastava, K. M. Nuovo Cim.; 26B: No. 2, 419-432(11 Apr 1975).

The effect of Hall current and finite electrical resistivity on the Rayleigh-Taylor instability of a viscous, incompressible, finitely conducting liquid in a downward gravitational field under the influence of a uniform magnetic field normal to gravity has been studied. The solution is characterized by a variational principle. With the help of the variational principle an approximate solution is obtained for the stability of a layer of fluid of constant kinematic viscosity and with an exponential density distribution. It has been found that finite resistivity and finite Larmor frequency do not introduce any instability in a potentially stable configuration. The potentially unstable configuration has been discussed numerically and compared with that given by Bhowmik. An appreciable change in the growth rate is observed in the presence of Hall current. The criterion for instability in the absence of Hall current remains unchanged. (auth)

14064 DECAY INSTABILITY OF THE ION ACOUSTIC WAVE. Seshadri, S. R. (Univ. of Wisconsin, Madison). Can. J. Phys.; 53: No. 6, 657-665(15 Mar 1975).

The parametric excitation of the longitudinal, plasma mode and the transverse, electromagnetic mode in a warm, uniform plasma investigated for the case in which the pump wave is another electromagnetic mode. The three interacting waves are assumed to propagate in the same direction. The longitudinal mode has two branches, namely, the electron plasma mode and the ion plasma mode. The parametric coupling of the longitudinal and the transverse waves in the presence of the pump wave leads to the interacting waves. Illustrative numerical results are presented for the parametric instabilities of the electron plasma oscillation which is a part of the electron plasma mode and those of the ion acoustic waves and the ion plasma oscillations which are parts of the ion plasma mode. The ion acoustic wave is efficiently excited when the pump and the idler wave frequencies are approximately equal to one and a half times the electron plasma frequency. (auth)

14065 INTERNAL KINK MODE IN A DIFFUSE PINCH WITH A NONCIRCULAR CROSS SECTION. Laval, G. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 34: No. 21, 1316-1320 (26 May 1975).

It is shown that the internal kink mode is no longer marginally stable within the kink-mode order in a plasma with noncircular cross section. For a step current density with a small ellipticity, the internal kink mode becomes unstable as soon as the rotational transform exceeds 2π close to the magnetic axis. (auth)

14066 NONLINEAR ANALYSIS OF THE INSTABILITY IN A MAGNETOHYDRODYNAMIC FLOW. Nedospasov, A.V.; Khait, V.D. (Academy of Sciences of the USSR). High Temp. 12: No. 4, 728-732 (Mar 1975).

The small-amplitude nonlinear oscillations are examined for a plasma flow traveling through crossed electric and magnetic fields; the oscillations arise from an instability due to the temperature dependence of the electric conductivity. (auth)

14067 PARAMETRIC INSTABILITY OF TRANSVERSE AND LANGMUIR WAVES IN A PLASMA. Lee, K. F. (Chinese Univ. of Hong Kong, Shatin). J. Plasma Phys.; 13: 317-325(Apr 1975).

The parametric excitation of transverse and Langmuir waves by an externally-driven electromagnetic field of frequency ω_0; $2\omega_p$ in a warm and collisional plasma is studied, using the fluid equations. By an application of the multiple-time-scale perturbation method, the threshold intensity and the growth rate above threshold are obtained. The results are compared with those of Goldman (Goldman, M. V., 1969, Nonlinear Effects in Plasmas (ed. G. Kalman and M. Feix), p.335, Gordon and Breach) and Prasad (Prasad, R., 1968, Phys. Fluids, 11, 1768), both of whom worked with a kinetic model. (auth)

14068 NEW, ALMOST ELECTROSTATIC, TEMPERATURE ANISTROPY INSTABILITY. Landau, R. W. (Tel Aviv Univ., Israel). J. Plasma Phys.; 13: 377-384(Apr 1975).

A new, purely growing instability has been found for a bi-Maxwellian plasma in a uniform magnetic field. Instability exists for $\beta_{11} = 4\pi nkT_{11}/B^2 > 0.591$ when $T_\perp = 0$, and ions are neglected. The growth rate is near the electron gyro frequency (or $\bar{v}/c$ the plasma frequency), and the polarization is almost electrostatic for almost perpendicular propagation. The instability is obtainable only from the complete dispersion relation. (auth)

14069 ORDINARY ELECTROMAGNETIC MODE INSTABILITY. Cheng, C. Z. (Univ. of Iowa, Iowa City). J. Plasma Phys.; 13: 335-348(Apr 1975).

The instability of the ordinary electromagnetic mode, propagating perpendicular to an external magnetic field, is studied for a single-species plasma with ring velocity distribution. The marginal instability boundaries for both the purely growing mode and the propagating growing modes are calculated from the instability criteria. The dispersion characteristics for various sets of plasma parameters are also given. The frequency bands of the propagating growing modes are centered at about $(n + \frac{1}{2})\omega_c$, where $n = 1,2, \ldots$, and the typical growth rates are of the order of cyclotron frequency and enhanced by increasing β_{11}. (auth)

14070 OBSERVATION OF EQUILIBRIUM AND DISRUPTIVE INSTABILITY IN A DIVERTOR-TOKAMAK CONFIGURATION IN THE DC OCTOPOLE. Prater, R.; Hamada, Y.; Freeman, R.; Moeller, C.; Tamano, T.; Ohkawa, T. (General Atomic Company, San Diego, California 92138). Phys. Rev. Lett. 34: No. 23, 1432-1435 (9 June 1975).

An Ohmic current has been inductively driven in the dc octopole. Resulting flux surfaces are similar to those of a tokamak with poloidal divertors. Quiet and reproducible magnetic-probe traces indicate that the plasma has obtained a stable equilibrium. For the safety factor on the axis less than unity, a current-disruptive instability is observed to redistribute current density from the peak to the wings of the spatial distribution. (auth)

14071 BACKSCATTER MEASUREMENTS FROM LASER-PRODUCED PLASMAS AT 10.6 μM. Mitchell, K.B.; Stratton, T.F.; Weiss, P.B. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Appl. Phys. Lett. 27: No. 1, 11-13 (1 July 1975).

The fraction of light backscattered from plasmas produced by 10.6-μm laser light focused on polyethylene slab targets is ~5% of the incident for intensities between 10^{13} and 10^{15} W/cm^2. Time-integrated measurements of the spectrum of backscattered light near 10.6 μm are presented. (auth)

14072 FINITE LARMOR RADIUS EFFECTS ON THE RAYLEIGH-TAYLOR INSTABILITY OF A ROTATING PLASMA OF VARIABLE DENSITY. Bhatia, P. K. (Jodhpur Univ. (India)); Steiner, J. M. (429865). Astrophys. Space Sci.; 34: No. 2, 459-465(May 1975).

The Rayleigh-Taylor instability in a rotating plasma of variable density has been investigated to include simultaneously the effects of viscosity and the finiteness of the ion Larmor radius. It is shown that, for a plasma in which the density is satratified along the vertical, the solution is characterized by a variational principle. Making use of this, proper solutions have been obtained for a semi-infinite plasma in which the density varies exponentially. The dispersion relation has been solved numerically and it is found that the influence of the effects of both FLR and viscosity is stabilizing. The Coriolis forces are found to have a dual role, stabilizing for small wave numbers and destabilizing for large wave numbers. The range of the small wave numbers, over which the Coriolis forces have a stabilizing influence, is found to increase with Coriolis forces. (auth)

14073 SUBHARMONIC SUPPRESSION OF A TRANSVERSE KELVIN-HELMOHLTZ INSTABILITY. Levine, A. M. (Richmond College of the City University of New York, Staten Island, New York 10300, USA); Decker, J. F. (Bell Labs., Murray Hill, N. J. (USA)). Phys. Lett., A; 53: No. 1, 107-108(19 May 1975).

A plasma density modulation applied at nearly twice the frequency of an unstable mode was observed to produce amplitude suppression exhibiting strong hysteresis. (auth)

14074 TWO STREAM INSTABILITY OF QUASIPARTICLES. Hasegawa, A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Phys. Lett., Z; 53: No. 1, 103-104(19 May 1975).

Two (or more) quasimonochromatic waves interacting in a nonlinear dispersive medium are shown to be unstable even if each wave is modulationally stable. (auth)

14075 ION WAVE INSTABILITY IN A COLLISIONAL MAGNETOPLASMA. Sharma, S. R.; Bhatnagar, T. N. (Rajasthan Univ., Jaipur (India). Dept. of Physics). Phys. Lett., A; 53: No. 1, 99-100(19 May 1975).

Temperature relaxation mechanism is found to have a destabilizing effect on ion waves propagating nearly across the magnetic field in the presence of streaming electrons. (auth)

14076 INSTABILITY OF THE TRIVELPIECE MODE IN BEAM-PLASMA SYSTEM. Idehara, T.; Miyama, N.; Ishida, Y. (Department of Applied Physics, Fukui University, Fukui, Japan). Phys. Lett., A; 53: No. 1, 97-98(19 May 1975).

Spatial growth of an electrostatic wave is observed in a beam-plasma system, and can be explained consistently as an instability of the Trivelpiece mode. (auth)

14077 LOW-FREQUENCY HELICAL INSTABILITY IN A HIGH-FREQUENCY ELECTRIC FIELD. Paverman, V.S.; Tskhakaya, D.D. (Tbilisi State University and Institute of Physics, Academy of Sciences of the Georgian SSR). Sov. Phys.—Tech. Phys. 19: No. 11, 1508-1509 (May 1975).

Low-frequency helical waves that propagate in an electron magnetoplasma in an external time-varying electric field are treated. These waves are unstable in a weak high-frequency field when certain decay conditions hold. (auth)

14078 INSTABILITIES IN INTERPENETRATING ELECTRON AND ION BEAMS. Soloshenko, I.A.; Katsubo, L.P. (Institute of Physics of the Ukrainian SSR, Kiev). Sov. Phys.—Tech. Phys. 19: No. 10, 1317-1320 (Apr 1975).

Collective oscillations are investigated in a synthesized plasma consisting of interpenetrating electron and ion beams. Instabilities are excited as in the case in which the electron component is at rest and when its velocity v_e exceeds that of the ion component v_i. The experimentally measured frequencies, growth rates, and phase velocities are found to be in qualitative agreement with theory. An effect is detected in which trapping of electrons by the wave field limits the amplitudes of the oscillations; this mechanism accelerates the electrons when $v_e=0$ and retards them when $v_e > v_i$. (auth)

14079 DRIFT INSTABILITY IN A WEAKLY IONIZED PLASMA. Putvinskii, S.V.; Timofeev, A.V. Sov. Phys.—Tech. Phys. 19: No. 10, 1295-1299 (Apr 1975).

It is shown that low-frequency ($\omega \ll \nu_i$) drift waves can be excited spontaneously in a current-free discharge when the ions are not fully magnetized ($\omega_i/\nu_i \sim 1$, $\rho_i/a \sim 1/2 - 1/3$). Here, ω_i is the ion cyclotron frequency, ν_i is the ion-neutral collision frequency, ρ_i is the ion Larmor radius and a is the characteristic scale length for changes in the plasma density. A comparison of theoretical and experimental results indicates that this instability has been observed.[1,2] In strong magnetic fields ($\omega_i/\nu_i \gg 1$, $\rho_i/a \ll 1$) the residual effect of incomplete ion magnetization has a stabilizing influence on the drift instability. (auth)

14080 NONLINEAR STATISTICAL THEORY FOR CONDENSATION OF LANGMUIR PLASMONS. III. ENERGY FLUX FOR PLASMA TURBULENCE. Khakimov, F.Kh.; Tsytovich, V.N. (V. I. Lenin Tadzhik State University, Dushanbe). Sov. Phys.—Tech. Phys. 19: No. 10, 1300-1302 (Apr 1975).

Analysis of the nonlinear stage of the modulation instability shows that the establishment of a steady-state spectrum and a level of

modulation waves is accompanied by a change in the direction of spectral pumping; plasmons are transferred from the "condensate" into the Landau-absorption region. (auth)

14081 MECHANISM FOR PLASMA LOSS FROM A MAGNETIC TRAP. Volosov, V.I. (Institute of Nuclear Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.—Tech. Phys. 19: No. 11, 1408-1411 (May 1975).

The interaction between plasma particles in a magnetic well with helical magnetic field lines (for example, in a stellarator) and the electric field due to a low-frequency (drift) instability is considered. It is shown that even when the amplitude of the electrostatic oscillations is small, $\varphi < kT_e/e$, the radial displacement of the particles (ions and trapped electrons) can be larger than the displacement computed from the neoclassical theory. When $\varphi \simeq kT_e/e$ the radial displacement of the particles is equal to the plasma dimension. The loss rate is determined by the time $\tau_p \simeq \gamma^{-1}$. For the collisionless drift mode it follows that $\tau_p \simeq k\tau_{Bohm}$, where τ_{Bohm} is the Bohm time. For most stellarator experiments $k \sim 1-10$; this quantity depends on both the magnetic parameters (average shear $\bar{\theta}$ and ϵ) and the plasma parameters (T_i/T_e and m_i/m_e). The present estimates are compared with experiment. (auth)

14082 COLLECTIVE MODES IN AN INHOMOGENEOUS BEAM INJECTED PLASMA. Coppi, B. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Bhadra, D.K. Phys. Fluids 18: No. 6, 692-698 (June 1975).

The effects of microinstabilities, which are excited in a confined plasma characterized by two ion components, e.g., a high temperature deuterium component and a low temperature tritium component, are investigated. The relevant growth rates depend on the radial temperature and density gradients of the hot ion population as well as on the electron temperature gradient. The main consequences of the excited modes can be the extraction of energy from the hot ion component, the scattering of weakly trapped and weakly circulating orbits for the same component, and the enhancement of the particle and thermal energy transport across the magnetic field for all ion and electron populations. (auth)

14083 EFFECT OF IMPURITIES ON DISSIPATIVE TRAPPED ION MODES. Dobrowolny, M.; Ross, D.W. (Fusion Research Center, University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 18: No. 6, 717-726 (June 1975).

The stability of dissipative trapped ion modes in the presence of impurity ions is investigated and compared with previous theories of these modes in pure plasma. The impurities are assumed to be either in the plateau or Pfirsch–Schlüter regime as is typical of either present day or the next generation of toroidal plasmas. The important effects of the impurities are found to be different depending on whether the parallel wave phase velocity is above or below the impurity thermal velocity. However, it can, in general, be stated that when the impurity density gradients are in the same direction as the electron and hydrogen ion density gradients, the impurity ions exert stabilizing effects on the modes. The critical density for stabilization of the modes is found to be significantly reduced, even at rather small impurity concentrations. On the other hand, cases of inverse impurity gradients are likely to be unstable. Numerical applications of the theory to nominal parameters of the PLT tokamak are given. (auth)

14084 RELATIVISTIC SPACE-CHARGE FLOW IN A MAGNETIC FIELD. Bergeron, K.D.; Poukey, J.W. (Plasma Theory Division-5241, Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 27: No. 2, 58-60 (15 July 1975).

An analytic model for space-charge-limited flow in relativistic diodes is presented which includes the effect of a transverse magnetic field below the critical field for magnetic insulation. Conditions for the validity of the model are investigated and comparison is made with recent experiments by Golden *et al.* (auth)

14085 STABILITY OF MAGNETICALLY CONFINED, HIGH-BETA PLASMA. Guest, G.E.; Hedrick, C.L.; Nelson, D.B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Fluids 18: No. 7, 871-874 (July 1975).

Plasma waves propagating perpendicular to the magnetic field in a high-beta, magnetically confined plasma can be unstable in configurations for which the guiding-center drifts are in the "favorable" direction. The basic instability mechanism is illustrated and the conditions for growth are obtained using the Maxwell and Vlasov equations in a slab model of the plasma. (auth)

14086 RESISTIVE INSTABILITIES IN GENERAL TOROIDAL PLASMA CONFIGURATIONS. Glasser, A.H.; Greene, J.M.; Johnson, J.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 18: No. 7, 875-888 (July 1975).

Previous work by Johnson and Greene on resistive instabilities is extended to finite-pressure configurations. The Mercier criterion for the stability of the ideal magnetohydrodynamic interchange mode is rederived, the generalization of the earlier stability criterion for the resistive interchange mode is obtained, and a relation between the two is noted. Conditions for tearing mode instability are recovered with the growth rate scaling with the resistivity in a more complicated manner than $\eta^{3/5}$. Nyquist techniques are used to show that favorable average curvature can convert the tearing mode into an overstable mode and can often stabilize it. (auth)

14087 DEFEAT OF SHEAR STABILIZATION BY PEAKING OF THE DIAMAGNETIC FREQUENCY PROFILE. Sauthoff, N.R.; Okabayashi, M.; Schmidt, J.A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 18: No. 7, 915-916 (July 1975).

The radial wave equation describing collisionless drift instabilities in plasma is solved including the effects of a peaked diamagnetic frequency profile. Radially localized fluctuations with no radial energy propagation are found in cases with sufficiently low shear and large peaking. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 13962, 15432, and 15437.

14088 (ANL/CTR-75-2) TOKAMAK EXPERIMENTAL POWER REACTOR STUDIES. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 517p. Dep. NTIS $13.60.

The principal results of a scoping and project definition study for the Tokamak Experimental Power Reactor are presented. Objectives are discussed; a preliminary conceptual design is described; detailed parametric, survey and sensitivity studies are presented; and research and development requirements are outlined. (auth)

14089 (CONF-750710-1) CURRENT AVERAGING AND COIL SEGMENTATION IN THE PROTECTION OF LARGER TOROIDAL SUPERCONDUCTING MAGNET SYSTEMS. Yeh, H. T.; Luton, J. N. (Oak Ridge National Lab., Tenn. (USA)). 1974. 12p. Dep. NTIS $4.00.

From international cryogenics materials conference; Ontario, Canada (Jul 1975).

Various aspects of the electrical protection problems of a large toroidal superconducting magnet system are discussed--especially the redistribution of coil currents and induced voltages, both due to inductive coupling--and some possible solutions are suggested. (auth)

14090 (IPP-4/122) SYSTEMS - A COMPUTER PROGRAM FOR EVALUATING THE MAIN PHYSICAL AND TECHNOLOGICAL PARAMETERS OF FUSION REACTORS. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Sep 1974. 30p. INIS.

7 figs.; 9 refs. With app.

Systems is a program system for evaluating the main physical and technological parameters of fusion reactors. The current version should be regarded as a preliminary one. Further refinements and extensions will be provided in the future. The first part of this report describes the calculation procedure and lists all formulas used. The second part is devoted to explaining the program structure and includes a series of remarks on the input and output operations. A reference list of all output quantities as well as an input and an output sample are presented in the appendix. (GE)

14091 (LA-5922-H) PARTIAL CHRONOLOGY OF Z-PINCH STUDIES AT LOS ALAMOS SCIENTIFIC LABORATORY, 1952–1975. Burkhardt, L. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 12p. Dep. NTIS $4.00.

A delineation is given of developments in toroidal (Perhapsatron) and linear (Columbus) Z-pinch studies since 1952 at the Los Alamos Scientific Laboratory. (auth)

14092 (LA-UR-75-865) DESIGN AND PERFORMANCE OF TWO 10 kA SUPERCONDUCTING SWITCHES. Blevins, D. J.; Lindsay, J. D. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 21p. (CONF-750531-4). Dep. NTIS $4.25.

From IEEE International Conference on Plasma Science; Ann Arbor, Michigan, USA (14 May 1975).

The transfer of energy from superconducting magnet coils with currents of 10,000 A or more with stored energy of 300 kJ or more using superconducting switches is discussed. Switching is done by driving the device to its normal resistive state by current pulsing to above its critical current. The construction and performance of two switches are described. (MOW)

14093 (MATT-1137) DESTRUCTION OF MAGNETIC SURFACES IN TOKAMAKS BY CURRENT PERTURBATIONS. Finn,

J. M. (Princeton Univ., N. J. (USA). Dept. of Physics). Jun 1975. Contract AT(11-1)-3073. 33p. Dep. NTIS $4.75.

Investigations are reported of the feasibility of the hypothesis that the disruptive instability in tokamaks is caused by the breakup of magnetic surfaces. The envisioned breakup is caused by the interaction of m equals 2, n equals 1 and m equals 3, n equals 1 helical perturbations or by the interaction of the m equals 2, n equals 1 perturbation and the m equals 1, n equals 0 toroidal field (with R/a equals 5). Both numerical and analytic work was done for two MHD equilibrium current profiles: parabolic [q approximately $(1 - r^2/2a^2)^{-1}$] and the peaked model (q approximately 1 + lambda r^2/a^2). For the parabolic profile, perturbation strengths of 1.5 percent are required to break up surfaces when m equals 2 and m equals 3 perturbations are present. When the m equals 2 perturbation alone interacts with the toroidal field, perturbation strengths greater than 4 percent are required. For the peaked model with q(0) equals 1.1, q(a) equals 3.7, perturbation strengths of 0.5 percent were found to be sufficient to break the surfaces when both m equals 2 and m equals 3 perturbations are present, whereas strengths of 1.5 percent are required when only the m equals 2 perturbation interacts with the toroidal field. These perturbation amplitudes are in reasonable agreement with experimental measurements. The peaked model permits breakup of surfaces for smaller perturbation strengths primarily because of its greater shear. (auth)

14094 (ORNL-TM-4965) SIMPLIFIED APPROACH TO ATTAINING A PROTON E-LAYER. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 15p. Dep. NTIS $4.00.

A simpler approach than proposed by Christofilos for producing a large proton E-layer is presented. Such a high-beta closed-magnetic-mirror configuration might permit burning the advanced fusion fuels DD and D^6Li in an economic, radiologically and chemically safer, structurally simple, reliable, steady-state, I-layer plasma-magnetic system. (auth)

14095 (UCID-16820) DT FUSION NEUTRON IRRADIATION OF BNL ALUMINUM OXIDE, UW-LLL METALLIC FOILS, LLL COBALT, AND LLL HYDRATED CALCIUM SULFATE. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jun 1975. Contract W-7405-Eng-48. 6p. Dep. NTIS $4.00.

The irradiation specifics for each target are briefly described. No results are given. (MOW)

14096 (UCID-16824) CONDITIONS FOR FIELD REVERSAL IN 2XIIB. Fowler, T. K. (California Univ., Livermore (USA) Lawrence Livermore Lab.). 24 Jun 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $4.00.

The calculations of field reversal by neutral injection carried out by Byers with the Superlayer code have thus far concentrated on varying the geometry of the injected beams. The trapped current is taken as a parameter, constant in time. Also, the only factor determining the containment of trapped ions is their orbit dynamics in the changing magnetic field. In addition, it is necessary to keep track of the actual trapping processes at a fixed injection current, and also ion losses (notably, by electron drag). Trapping and drag were studied briefly but the detailed orbit dynamics that requires the code was not carried out. Instead beta greater than 1 is taken as an approximate criterion for reversal and then the question of injection current I necessary to build-up the density to the equivalent of beta greater than 1 before being limited by other processes was studied. Since for the initial target plasma beta greater than 1, it is necessary to increase either n or T (or both). (auth)

14097 (UCRL-76091) THEORETICAL AND PRACTICAL ASPECTS OF ENERGY STORAGE AND COMPRESSION. Zucker, O. S. F.; Bostick, W. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Apr 1975. 24p. (CONF-741113-12). Dep. NTIS $4.25.

From international conference on energy storage, compression and switching; Torino, Italy (5 Nov 1974).

The theoretical and experimental aspects of energy storage and compression are reviewed. The role of complementary energy modes combined with nonlinearities in energy compression is described. The need for "coherent nonlinearity" for efficient compression is emphasized. Various fundamental methods for compressions are described. Quantum mechanical limitations are discussed. Energy storage is reviewed from a theoretical and practical point of view with emphasis on new approaches. (auth)

14098 CORRUGATED MIRROR-CYCLOTRON FREQUENCY DIRECT CONVERSION SYSTEM (COMI-CYFER). Forrester, A. T.; Busnardo-Neto, J.; Crow, J. T. (Univ. of California, Los Angeles). IEEE Trans. Plasma Sci.; PS-3: No. 1, 23-30(Mar 1975).

In this scheme the plasma escaping from a mirror machine is split into an array of long narrow beams by means of a grid of iron slabs. For proper shaping of the slabs, the increased mirror ratio at the iron causes acceptably low beam interception. After spherical expansion of the magnetic field containing the escaping plasma, the electrons are repelled by non-intercepting grids. A spatially alternating electric and/or magnetic field which follows is converted to an alternating or rotating force by the motion of the ions. At sufficiently low velocity, this force resonates with the cyclotron frequency and sweeps the ions to collector plates. With average ion energies at 293 keV an efficiency of 85 percent can be obtained in a system whose size is much smaller than other proposed direct conversion systems. For a 74 percent efficiency, only 186 keV ions are required and the system becomes extraordinarily compact. (auth)

14099 COMPARISON OF THE CROSS-SECTION SENSITIVITY OF THE TRITIUM BREEDING RATIO IN VARIOUS FUSION-REACTOR BLANKETS. Alsmiller, R. G. Jr.; Santoro, R. T.; Barish, J.; Gabriel, T. A. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 57: No. 2, 122-128(Jun 1975).

For several proposed fusion-reactor-blanket designs, the changes in the tritium breeding ratios due to estimated errors in nuclear cross-section data are presented and compared. The designs considered are those proposed at the Oak Ridge National Laboratory, the reference theta-pinch reactor design proposed at the Los Alamos Scientific Laboratory, and the reference fusion power plant design proposed at the Princeton Plasma Physics Laboratory. Results are presented for the changes in the breeding ratios due to estimated energy-dependent errors in various partial cross sections of ^6Li, ^7Li, C, Be and F. The $^7Li(n,n')$alpha,t cross section, the Be(n,2n') cross section, and the fluorine cross sections are found to introduce changes of the order of a few percent in the breeding ratios for the various designs. Sensitivity profiles that show the changes in the breeding ratios due to changes in these cross sections in specific energy ranges are presented. (auth)

14100 CALCULATIONAL METHODS FOR NUCLEAR HEATING. Part I. Theoretical and Computational Algorithms. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Nucl. Sci. Eng.; 56: No. 4, 360-380(Apr 1975).

Methods are investigated for calculating nuclear heating and dose due to the interaction of nuclear radiation with matter. A theoretical model is developed for calculating neutron fluence-to-kerma factors (kerma equals kinetic energy released in materials) from basic nuclear data. No major simplifying assumptions are introduced, and the accuracy of the calculated fluence-to-kerma factors depends only on the availability and accuracy of the basic nuclear data. Based on this theoretical model, a computer program called MACK was written to calculate fluence-to-kerma factors from nuclear data in ENDF format. An algorithm for investigating the validity of the kerma factors by using an integral energy balance was also developed. The validity of the theoretical model and the correctness of the computation of the kerma factors obtained in the present work were verified through the use of this algorithm. Comparison of thesse kerma-factor results with previous work showed that they provide a considerable improvement in kerma-factor and nuclear-heating calculations. It is also shown that there is currently some inconsistency in preserving the energy between the basic neutron interaction data and the gamma-ray production data. It is suggested that the photon-production matrix be processed simultaneously with the neutron kerma factors to ensure consistency. (auth)

14101 CALCULATIONAL METHODS FOR NUCLEAR HEATING. Part II. Applications to Fusion-Reactor Blankets and Shields. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Nucl. Sci. Eng.; 56: No. 4, 381-398(Apr 1975).

The calculational methods developed for nuclear heating in an earlier paper are applied to fusion-reactor blankets and shields. The study shows that the nuclear heating in fusion-reactor blankets has been previously overestimated and is limited to approximately 16 MeV per DT neutron in the absence of beryllium or fissionable materials. Methods are also examined for increasing the energy multiplication in the blanket by maximizing the rates of exothermic reactions. A general study of the sensitivity of the neutron energy deposition to changes in basic nuclear data is carried out. (auth)

14102 FUSION REACTORS. Schwarz, K.; Bernhauer, W. Energ. Tech.; 25: No. 9, 229-230(Sep 1973). (In German).

The principles, status of development, and purposes of fusion reactors and the primary difficulties encountered in their development are briefly reviewed. (JSR)

14103 HOW CANADA COULD GET INTO FUSION RESEARCH AND CAPITALIZE ON CANDU TECHNOLOGY. Stangeby, P. C.

(Univ. of Toronto); Robinson, J. E. Sci. Forum; 8: No. 1, 7-9 (Feb 1975).

The technical capability acquired as a result of experience with the CANDU fission reactor has put Canada in a strong position to contribute to key engineering aspects of fusion reactors. Unlike most other industrial nations, however, Canada has made no major commitment in the area of fusion research. By forming collaborative links with other world fusion programs, Canada could maintain a credible position in this field. (CA)

14104 MATERIAL PROBLEMS IN FUSION REACTORS. Gregory, B. C.; Martel, J. G.; St-Jacques, R. G.; Terreault, B. (Inst. National de la Recherche Science, Varennes, Quebec). J. Can. Ceram. Soc.; 47-51(1974).

As the scientific feasibility of controlled thermonuclear fusion becomes more and more certain, scientists are beginning to concern themselves with the problems of the technological feasibility or fusion reactors. Materials are one of the focal points of these technological problems. The fusion reactor concepts which are presently being proposed and the various problems arising are discussed. In particular, the following specific problems are considered: first wall sputtering due to neutron and energetic ion bombardment, and the evaporation and blistering of this first wall. (auth)

14105 FUSION REACTOR PHYSICS: PRINCIPLES AND TECHNOLOGY. Kammash, T. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1975). 506p.

The following chapters are included: (1) fusion power feasibility, (2) basic processes and balances in fusion reactors, (3) neutronics in fusion reactors, (4) neutral beam heating, (5) plasma heating by relativistic electrons, (6) rf heating, (7) adiabatic compression and heating, (8) dynamics and control of fusion reactors, (9) environmental aspects--thermal efficiency and waste heat, (10) fission–fusion hybrid systems, (11) inertial confinement systems, (12) radiological aspects, (13) design considerations of fusion reactors, (14) radiation damage, (15) heat removal and thermal considerations in blankets, and (16) approaches to fusion power. (MOW)

14106 CURRENT STATUS AND THE OUTLOOK FOR FUSION POWER. Hirsch, R. L. (Atomic Energy Commission, Washington, DC). Combustion.; 46: No. 12, 38-47(Jun 1975).

The present status of the CTR research program is outlined. The US program to develop practical fusion power is described. A general description is given of a projected fusion power plant. (MOW)

14107 ELECTRON BEAM–DEUTERATED TARGET EXPERIMENTS. Freeman, B. L. Jr. Davis, CA; Univ. of California (1974). 127p. University Microfilms Order No. 75-8332. Thesis (Ph. D.).

The Pulserad 422 electron beam facility at the Lawrence Livermore Laboratory was used to investigate the interaction of an intense electron beam with a deuterated target assembly. The performance of the apparatus, consisting of a deuterated polyethylene (CD_2) cathode tip, an insulated CD_2 disk with a tapered hole through its axis in the anode plane, and an insulated rear target of CD_2, was monitored with neutronic, optical, and electrical measurements. Open-shutter and image-converter photographs comprise the main optical measurements. The electrical characteristics observed were the voltage and current at various locations in the geometry along with microwave observations in the area between the front and rear targets. Neutronic information was obtained in the form of total yield from silver activation, fission foil track and sulfur activation methods, and time-resolved yield with time-of-flight oscillographs from scintillator-photomultiplier detectors. Average neutron total yields of 10^{10} n/pulse were obtained with the standard CD_2 target geometry, and a high-energy neutron group was reproducibly observed by time-of-flight when CD_2 had been used in the cathode tip, anode, and rear target. An energy assignment of 14 MeV for this peak would not be inconsistent with other data obtained. (Diss. Abstr. Int., B)

14108 ULTRAVIOLET SOURCE SUITABLE FOR TOKAMAK PREIONIZATION. Smeulders, P. (Association Euratom-CEA sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, Boite Postale n° 6, 92260 Fontenay-aux-Roses, France). Rev. Sci. Instrum. 46: No. 7, 909-910 (July 1975).

In order to ionize molecular deuterium a photon energy greater than 15.6 eV is required. This is created by radiation from bombardment of a thick wall by energetic electrons, as in x-ray tubes. A high voltage pulse extracts the electrons by field emission from the sharp pointed central electrode and accelerates them to the cylindrical anode. The degree of ionization is measured with an ionization cell and has been measured at pressures from 5×10^{-6} up to 5×10^{-4} Torr D at a distance of 70 cm from the source, averaged over the volume of the chamber. This made it possible to start discharges in the T.F.R. (Tonomav de Fontenay-aux-Roses) Tokomak from as low at 10^{-5} giving an appreciable increase in the range of working pressures of the T.F.R. experiment. (auth)

14109 GENERALIZED CRITERION FOR FEASIBILITY OF CONTROLLED FUSION AND ITS APPLICATION TO NONIDEAL DD SYSTEMS. Maglich, B.C.; Miller, R.A. (Migma Institute of High Energy Fusion, Fusion Energy Corporation, P.O. Box 2005, Princeton, New Jersey 08540). J. Appl. Phys. 46: No. 7, 2915-2923 (July 1975).

Eighteen terms are missing from the energy balance of the Lawson criterion; most of them correspond to nonnegligible effects that must be present in real physical systems. A quantitatively and qualitatively different criterion for controlled fusion is obtained. It requires that, in addition to the product $n\tau$, three important independent conditions be satisfied. We conclude that conditions for controlled dd fusion are more advantageous at nuclear physics energies $\sim$1 MeV than at thermonuclear temperatures. (auth)

14110 LASER FUSION TARGET ILLUMINATION SYSTEM. Thomas, C.E. (KMS Fusion, Inc., P. O. Box 1567, Ann Arbor, Michigan 48106). Appl. Opt. 14: No. 6, 1267-1273 (June 1975).

Laser fusion experiments require the focusing of very intense pulsed laser beams onto very small fuel pellets. All reported experiments to date have used lenses to focus one or more laser beams onto the target. This paper describes a combined refractive/reflective illumination system that provides nearly uniform irradiance with nearly orthogonal incidence over the complete spherical target, with only two laser beams. This illumination system was used in the experiments that produced the first known symmetric target implosions. Furthermore, these experiments produced what we believe were the first thermonuclear neutrons generated by a laser-driven implosion. (auth)

14111 ELLIPSOIDAL ILLUMINATION SYSTEM OPTIMIZATION FOR LASER FUSION EXPERIMENTS. Brueckner, K.A.; Howard, J.E. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). Appl. Opt. 14: No. 6, 1274-1278 (June 1975).

It is shown that nearly uniform and orthogonal illumination of a spherical target may be realized by defocusing the ellipsoidal mirror system devised by C. E. Thomas. (auth)

14112 POSSIBLE INTERPRETATION OF THE MAXIMUM PLASMA PRESSURE IN A STELLARATOR. Akshanov, B.S.; Manzyuk, N.A.; Muratov, V.I.; Pyatov, V.N.; Sebko, V.P.; Tyupa, V.I. (Khar'kov State University). JETP Lett. 21: No. 4, 94-96 (20 Feb 1975).

We demonstrate the possibility of splitting the magnetic configuration of the stellarator into resonant structures in the presence of a plasma. This fact can lead to a limitation on the maximum plasma pressure in the trap. (auth)

Wave Phenomena

Refer also to abstracts 13953, 14064, 14071, 14077, 15274, and 15416.

14113 (AD/A-002831) INCIDENCE OF A PLANE ELECTROMAGNETIC WAVE ON A MOVING JUMP IN IONIZED GAS DENSITY. Blagoveshchenskii, A. S.; Borisov, V. V. Translated by C. S. Nack from Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 9, 1314-1319(1972). 15p. (FTD-HT-23-0027-75). NTIS $3.25.

14114 (COO-2081-23) NONLINEAR PHENOMENA IN COLLISIONLESS PLASMAS. Progress Report, September 1, 1974–August 31, 1975. Aamodt, R. E. (Colorado Univ., Boulder (USA)). 1975. Contract AT(11-1)-2081. 8p. Dep. NTIS $4.00.

The nonlinear evolution of unstable collective modes common to conventional mirror machines is being analyzed in order to evaluate measurable saturation amplitudes, spectrum properties, and concomitant particle loss rates. The nonlinear dispersion relation for the classic drift-cone mode, including nonlinear E x B VECTOR convective cells is presently being evaluated to find its self-saturation properties. Large amplitude rf heating mechanisms, localized mode nonlinearities, and propagation and amplification of transverse modes in collisionless inhomogeneous plasmas have also been partially evaluated. (auth)

14115 (COO-2081-24) RADIATION COUPLING OF BERNSTEIN MODES IN LOSS CONE-LIKE MAGNETOPLASMAS. Hoffman, J. M. (Colorado Univ., Boulder (USA)). May 1975. Contract AT(11-1)-2081. 32p. Dep. NTIS $4.75.

The dispersion relation for waves in an electron magnetoplasma having electron distribution f_0(v/sub z/, v/perpendicular to/) equals ($\frac{1}{2}$ pi u)delta(v/sub perpendicular to/-u)delta(v/sub z/) is studied. The stability properties of the system are investigated and it is found that there exist regions where the electromagnetic and electrostatic modes can couple. The stability prop-

erties of the zero frequency mode are also discussed. Propagation of the modes in a weakly inhomogeneous plasma is analyzed and the transfer of energy, both into and out of the plasma, is considered. Through knowledge of the above, inferrence is drawn to the rf heating problem as well as the radiation problem. (auth)

14116 (ERDA-tr-40) MULTIPLE GENERATION OF LANGMUIR SOLITARY WAVES IN THE RESONANT REGION OF INHOMOGENEOUS PLASMA. Sinin, V. A. 1974. Translation of Russian Preprint No. 33. 7p. Dep. NTIS $4.00.

Spacial redistribution of a Langmuir field is experimentally detected in a region of plasma resonance that appears in the established state with $E_0/E_p \geq 2 \times 10^{-4}$. A comparison is made with the theory of deformation of a resonance region in a strong high frequency field. (auth)

14117 PROPAGATION OF WAVE MODES IN ULTRARELATIVISTIC MAGNETOACTIVE PLASMA. Blandford, R. D. (Cambridge Univ., Eng.). Mon. Not. R. Astron. Soc.; 170: No. 3, 619-632(Mar 1975).

Some results on the propagation of undamped wave modes in fully relativistic, magnetoactive plasma are presented. A specific isotropic particle distribution function is introduced that is uniform in phase space up to a limiting particle energy and zero for higher energies. If only the electrons contribute significantly to the dispersion, it is shown that undamped "quasi-ordinary" and "quasi-extraordinary" modes can propagate when the wave frequency is less than the relativistic gyro frequency of the most energetic electrons. When this inequality is reversed, there are limited ranges of field strength and propagation direction for which one quasi-ordinary and two quasi-extraordinary modes can propagate. There are additional propagating modes if the protons contribute significantly to the dispersion. (auth)

14118 EXPERIMENTAL STUDY OF DRIFT WAVES IN A WEAKLY IONIZED PLASMA. Odajima, K.; Hatta, Y. (Tohoku Univ., Sendai). pp 254-257 of Third International Conference on Gas Discharges. London; Institution of Electrical Engineers (1974).

From 3rd international conference on gas discharges; London, England (9 Sep 1974).

The experimental study of the frequency and the growth rate of drift waves in a weakly ionized discharge plasma is reported. Their dependence on some experimental parameters are measured both in unstable and stable regions by virtue of the resonant characteristics at the drift wave frequency. The experimental data shown are mainly those in the stable regions in which nonlinear phenomena can be neglected. (UK)

14119 SECULAR FREE SOLUTION UP TO THIRD-ORDER OF RELATIVISTIC HOT DISSIPATIVE PLASMA EQUATION FOR ELECTROSTATIC FIELD. Chandra, S. K. (Krishna Chandra Coll, W. Bengal, India). Czech. J. Phys.; B24: No. 12, 1338-1344 (1974).

The perturbation method of Lindstedt is applied to study the relativistic nonlinear effects for longitudinal electrostatic waves in a hot dissipative plasma having no static electric or magnetic field. Amplitude dependent frequency and wave-number shifts are derived including relativistic corrections. (auth)

14120 PENETRATION OF AN ORDINARY WAVE INTO A WEAKLY INHOMOGENEOUS MAGNETOPLASMA AT OBLIQUE INCIDENCE. Preinhaelter, J. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; B25: No. 1, 39-50(1975).

A theory is given describing the propagation of high-frequency electromagnetic waves in a plane-stratified weakly inhomogeneous plasma. The density gradient is supposed to be perpendicular to the external magnetic field and the wave vector is expected not to be generally parallel to the plane given by both the preceding vectors. The analysis points out that the ordinary wave can penetrate through the plasma resonance region if the direction of vacuum wave vector is chosen appropriately. Analytical expressions for the reflection and transmission coefficients are obtained and their dependence on the direction cosines of the wave vector of the incident is studied. The paper further shows in outline that, after transmission through the plasma resonance, the ordinary wave is transformed into an extraordinary wave and the latter is reflected back to the region of the hybrid resonance. In this region, the extraordinary wave is fully transformed into the Bernstein modes. (auth)

14121 ENERGY-MOMENTUM DESCRIPTION OF ELECTROSTATIC WAVES IN MAGNETOACTIVE PLASMAS. Lacina, J. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; B25: No. 1, 10-38(1975).

The physical mechanism of the energy-momentum transfer governing the propagation of electrostatic waves in collisionless plasmas is presented. Plasma is supposed to be immersed in external uniform crossed magnetic and electric fields. The equilibrium plasma, determined by a stationary distribution of charged particles, is assumed to be generally anisotropic and weakly nonuniform. The changes in macroscopic quantities (in the kinetic energy of perpendicular and parallel motion, etc.) due to the self-consistent wave-particle interaction are derived. It is shown, that the corresponding dispersion equation is identical with the energy-momentum balance equations expressed in the wave frame. A new expression of the energy of waves (plasmons) is given, which ensures the energy-momentum balance equations to be mutually independent. This differs from the usual expression of the wave energy leading to energy-momentum balance equations which are not mutually independent. (auth)

14122 ELECTROMAGNETIC PULSES AT THE BOUNDARY OF A NONLINEAR PLASMA. Satorius, E. H. Pasadena, CA; California Inst. of Tech. (1975). 116p. University Microfilms Order No. 75-9538.

Thesis (Ph. D.).

An investigation was made of the behavior of strong electromagnetic pulses at the boundary of a nonlinear, cold, collisionless, and uniform plasma. The nonlinearity considered here is due to the nonlinear terms in the fluid equation which were used to describe the plasma. Two cases are studied. First, the case where there is a voltage pulse applied across the plane boundary of a semi-infinite, nonlinear plasma is discussed. Two different voltage pulses are considered, i.e., a delta function pulse and a suddenly turned-on sinusoidal pulse. The resulting electromagnetic fields propagating in the nonlinear plasma are found in this case. In the second case, the reflection of incident E-polarized and H-polarized, electromagnetic pulses at various angles of incidence from a nonlinear, semi-infinite plasma are considered. Again, two forms of incident pulses are considered: a delta function pulse and a suddenly turned-on sinusoidal pulse. In case two, the reflected electromagnetic fields are found. In both cases, the method used for finding the fields is to first solve the fluid equation (which describes the plasma) for the nonlinear conduction current in terms of the electric field using a perturbation method (since the nonlinear effects are assumed to be small). Next, this current is substituted into Maxwell's equations, and finally the electromagnetic fields which satisfy the boundary conditions are found. (Diss. Abstr. Int., B)

14123 RADIATION FROM A LOOP ANTENNA IN COMPRESSIBLE PLASMA. Agarwal, D. C. (Univ. of Allahabad, India). Indian J. Theor. Phys.; 22: No. 2, 41-50(Jun 1974).

The radiation from a loop antenna in a compressible plasma is discussed. Expressions for radiation resistance due to plasma wave radiation and electromagnetic wave radiation are derived and they are calculated as a function of the ratio of ω_p/ω. (auth)

14124 INVERSE METHODS FROM SCATTERING THEORY APPLIED TO A SPHERICAL PLASMA. Miodek, I. I. Bloomington, IN; Indiana Univ. (1974). 81p. University Microfilms Order No. 75-8992.

Thesis (Ph. D.).

A method is presented for solving the inverse problem for a set of second order ordinary differential equations given data at finite distance from the origin. The form of these equations is readily related to the radial time-independent Schroedinger equation and in turn to the linearized radial equation of a spherically or cylindrically symmetric cold plasma which has been perturbed by an oscillatory electrical potential, of fixed frequency, applied to its surface. Subject to certain open questions of stability, the inverse problem for the plasma is solved; i.e., its (heavy) ion distribution is constructed from the normal logarithmic derivative of the electric potential at the surface. This method is motivated by R. G. Newton's approach to the fixed energy inverse scattering problem for spherically symmetric potentials in the Schroedinger equation. In particular a representation is given of the regular solutions of the radial equation which involves a set of intermediary constants via which the data can be fed in, and from which both the Schroedinger potential V/sub s/(r), and the radial solutions can be generated. The derivation is elementary in nature and assumes that $r^2V/\text{sub } s/(r)$ is analytic in r/sup a/ near r equals 0 with Real (a) greater than zero. Some generalizations are also given. (Diss. Abstr. Int., B)

14125 DESTABILIZATION OF HYDROMAGNETIC DRIFT-ALFVEN WAVES IN A FINITE PRESSURE COLLISIONAL PLASMA. Tang, J. T. Los Angeles; Univ. of California (1974). 123p. University Microfilms Order No. 75-9439.

Thesis (Ph. D.).

In a finite beta (beta equals $8\pi\, n_0kT_0/B_0^2$) plasma, where the plasma pressure n_0kT_0 is an appreciable fraction of the confining magnetic field energy-density $B_0^2/8\pi$, density-gradient driven drift waves couple with Alfven waves when the phase velocities

of the two waves become comparable. The resulting hydromagnetic drift-Alfven waves separate into two branches--a drift mode and an Alfven mode, with both modes exhibiting magnetic field and localized density fluctuations near the coupling point. The dispersion relation of the collisional drift-Alfven wave is derived by using a slab-geometry, two-fluid model which includes finite beta, electron-ion collisions, ion-ion collisions, finite ion larmar radius, temperature fluctuations, and an axial electron current. A hydromagnetic drift mode is found to be unstable in a moderately dense plasma. A localized "Alfven" mode is destabilized only with the passage of an axial current along the plasma column. In order to check the theoretical predictions an experiment is performed in a finite-beta plasma of density n_0 equals 10^{13}-10^{15} cm^{-3} and temperature T/sub e/ approximately T/sub i/ equals 1-7 eV. (Diss. Abstr. Int., B)

14126 PLASMA SCATTERING OF ELECTROMAGNETIC RADIATION. Sheffield, J. New York; Academic Press, Inc. (1975). 314p.

The following chapters are included: (1) scattered power spectrum, (2) incoherent scattering-low-temperature plasma, (3) constraints on scattering experiments, (4) optical systems, (5) scattered spectrum for a low-temperature plasma-theory, (6) scattering from a low-temperature stable plasma, B equals 0: experiment, (7) scattering from a magnetized plasma, (8) scattering from a high-temperature plasma, and (9) scattering from unstable plasma. (MOW)

14127 INTERFERENCE STRUCTURE IN THE FAR FIELD OF THE RESONANCE CONE. Boswell, R. W.; Gonfolone, A. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Phys. Lett., A.; 51: No. 8, 485-486(5 May 1975).

The interference structure of the resonance cone below the electron gyrofrequency (Whistler mode propagation) has been observed with electric and magnetic antennas in a large volume experimental magnetoplasma at distances greater than a wavelength from the transmitter. (auth)

14128 SATURATION TIME AND GROWTH RATE OF PARAMETRICALLY EXCITED ION ACOUSTIC WAVES. Martin, D.; Leprince, P. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Plasmas). Phys. Lett., A; 51: No. 8, 487-489 (5 May 1975).

The amplitude evolution of parametrically excited ion acoustic waves is shown. The instabilities are generated by a strong electric field applied to a krypton plasma column. (auth)

14129 INTERACTION BETWEEN PULSE SIGNALS IN A PARAMETRICALLY UNSTABLE PLASMA. Chmyrev, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 18: No. 3, 335-345(1975). (In Russian).

The space and time development of initial perturbations in the decay process of an intensive high-frequency pump wave was investigated taking into account interacting waves coming out of the instability regions. The interactions between opposite wave beams of the finite duration in the region of the given low-frequency wave turbulence was considered. Nonlinear distortions of the shape of pulses coming out of the interaction region were studied. (auth)

14130 ACTION CONSERVATION IN THE PRESENCE OF A HIGH-FREQUENCY FIELD. Kaufman, A. N.; Stenflo, L. (Univ. of California, Berkeley). Plasma Phys.; 17: No. 5, 403(May 1975).

In the presence of a high frequency field, which strongly modifies the plasma normal modes and their coupling coefficients, the Manley-Rowe condition for action conservation remains valid. (auth)

14131 DISPERSION RELATION OF HIGH FREQUENCY WAVES IN A BEAM-PLASMA SYSTEM. Nyack, C. A.; Christiansen, P. J. (Univ. of the West Indies, Barbados). Plasma Phys.; 17: No. 5, 355-359(May 1975).

The dispersion relation of electron plasma waves in a beam-plasma system has been investigated experimentally and compared with numerical calculations using different radial density distribution functions in an attempt to use these waves for accurate determination of the electron density. It is found that calculations using the linear dispersion relation gives a good fit to the experimental data although test waves are launched in the presence of large amplitude waves excited by the beam-plasma system. However, the existence of a multiple peaked frequency spectrum is reflected in the dispersion relation as a steplike distortion. (auth)

14132 ELECTROSTATIC ELECTRON-CYCLOTRON WAVES IN PLASMA WITH A LOSS-CONE DISTRIBUTION. Karpman, V. I.; Alekhin, Ju. K.; Borisov, N. D.; Rjabova, N. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Plasma Phys.; 17: No. 5, 361-372(May 1975).

An analytical investigation and numerical solutions of the dispersion equation for electrostatic waves in plasma with a loss-cone velocity distribution are presented. The general structure of the dispersion branches is elucidated and the maximum growth rates found for different sets of plasma parameters. The results obtained provide a basis for treating magnetospheric and laboratory experimental results concerning electrostatic waves with frequencies close to $(m + \frac{1}{2})\omega_c$. (auth)

14133 RECURRENCE OF ION WAVES AND SOLITON-LIKE INTERACTION. Watanabe, S.; Ishihara, O.; Tanaca, H. Yokohama National Univ., Japan). Plasma Phys.; 17: No. 5, 345-353(May 1975).

Nonlinear interaction of ion waves has been studied in a slightly unstable plasma in which the waves could propagate without dissipation over a long distance. Recurrence of waves during propagation is observed under two different initial conditions, i.e., purely sinusoidal or consisting of the fundamental and the second harmonic. In the latter case, the recurrence has the appearance of a soliton, reversible scattering successively taking place during continuous wave propagation. The recurrence length, which mainly depends on the dispersive properties of the plasma, is in good agreement with theory based on an extension of the Korteweg-de Vries equation which takes into account the effect of finite ion temperature. (auth)

14134 THE DEPOLARIZATION OF ELECTROMAGNETIC RADIATION IN A RANDOM MEDIUM. Propagation in a Cold Plasma. Bourret, R. Rev. Cethedec; 11: No. 40, 87-102(1974).

The application of stochastic perturbation theory to the propagation of electromagnetic radiation in a cold plasma with random magnetic inhomogeneities leads to a field equation for the propagation of the coherence matrix of the field. This has nine independent components since the longitudinal mode must be included. An exact solution is obtained leading to simple expressions for the Stockes parameters as a function of distance and one physical parameter characterizing the cold plasma. While the total polarization decays exponentially, it is found that the ratio of elliptical to linear polarization increases with propagation distance in an exponential fashion. (FR)

14135 WAVE PROPAGATION IN A PLASMA IN THE PRESENCE OF A SPATIALLY UNIFORM EXTERNAL PERIODIC MAGNETIC FIELD. Das, K. P. (Univ. of Kalyani, India). J. Plasma Phys.; 13: 327-334(Apr 1975).

Starting from the kinetic equation and Maxwell's equations, a dispersion relation is obtained for wave propagation through a fully-ionized plasma along a spatially-uniform, external, periodic magnetic field $B_0\cos\omega_0 t$, and several excitation conditions are deduced. (auth)

14136 EXCITATION OF LONGITUDINAL ELECTROMAGNETIC WAVES IN PLASMA BY HOLLOW RELATIVISTIC ELECTRON BEAM. Ivanov, S. T. (Univ., Sofia). Bulg. J. Phys.; 1: No. 3, 280-291(1974). (In Russian).

The interaction of a hollow relativistic electron beam with plasma in a metal jacket is discussed in electrostatic approximation. A steady external magnetic field is applied to the system. The interaction of the beam with plasma filling the whole wave guide, and with plasma determined by the boundaries of the beam, i.e., hollow plasma, was also studied. The first case refers to an interaction of the beam with preliminarily generated plasma and the second--to plasma generated by the beam itself under impulse conditions. The dispersion equation is analyzed within two opposite limits, short and long waves, in relation to the cross-section dimensions of the system. The spectra and increments as well as the relative width of the spectra of the excited waves, were obtained. It was shown that the geometry of the beam affects the nature of the developing instabilities both quantitatively and qualitatively. (auth)

14137 ELECTROMAGNETIC SURFACE-WAVE INTERACTIONS WITH A SEMI-INFINITE SINGLE STREAM OF PLASMA. Yasumoto, K. (Faculty of Engineering, Kyushu University, Fukuoka-shi, 812, Japan). J. Appl. Phys. 46: No. 7, 2941-2945 (July 1975).

The characteristics of an electromagnetic surface wave interacting with a semi-infinite single stream of a cold collisionless plasma are investigated by taking the plasma as a moving deformable polarized medium. The surface-wave dispersion equation shows the coupling of four waves, which are, approximately, the fast and slow space-charge waves in the plasma stream and the two waves in the free space whose phases progress in the same and opposite directions to the plasma stream. Compared to the analysis which has regarded the plasma stream as an equivalently stationary anisotropic plasma, the surface waves show drastically different characteristics. It is shown that there are no instabilities of the surface waves for any drift velocity of the plasma. (auth)

14138 EXCITATION OF ALFVÉN WAVES BY HIGH-ENERGY IONS IN A TOKAMAK. Rosenbluth, M.N.; Rutherford, P.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 34: No. 23, 1428-1431 (9 June 1975).

It is shown that shear Alfvén waves can be destabilized by resonance with high-energy "beam" ions near the magnetic axis in a tokamak, if the beam is radially nonuniform. (auth)

14139 ANALYSIS OF THE RADIATION BACKSCATTERED FROM A LASER-PRODUCED PLASMA. Jannitti, E. (Centro Gas Ionizzati, C.N.R., Università di Padova, Italy); Malvezzi, A.M.; Tondello, G. J. Appl. Phys. 46: No. 7, 3096-3101 (July 1975).

The light backscattered from a plasma produced by focusing a 1-GW Q-switched ruby laser has been measured. The reflection coefficient of the plasma is of the order of 1–2% and the reflected energy increases with the incident energy. The backscattered light is Doppler shifted; the shift is not uniform but varies markedly along the focal spot indicating a concave reflecting layer penetrating into the target with velocities of (2–4) $\times 10^6$ cm/sec. The second harmonic of the ruby laser is also present in the backscattered light. (auth)

14140 PARTICLE ACCELERATION BY A NON-LINEAR LANGMUIR WAVE IN AN INHOMOGENEOUS PLASMA. Karpman, V. I.; Istomin, J. N.; Shklyar, D. R. (Izmiran, Moscow Region, 142092, USSR). Phys. Lett., A; 53: No. 1, 101-102(19 May 1975).

An expression for the average particle distribution function disturbed by a nonlinear Langmuir wave in an inhomogeneous plasma is derived. Particle acceleration due to the resonant wave-particle interaction is investigated. (auth)

14141 EFFECT OF TRAPPED PARTICLES IN AN ELECTROSTATIC WAVE ON THE WHISTLER MODE. Kulkarni, V. H.; Das, A. C. (Physical Research Lab., Ahmedabad (India)). Phys. Lett., A; 53: No. 1, 94-96(19 May 1975).

It is shown that there exists a new series of resonances due to the interaction between a whistler propagating along an ambient magnetic field and the particles which are trapped in a large amplitude electrostatic wave. These resonances seem to produce sideband growths of the whistler. (auth)

14142 ENERGY OF CHARGED PARTICLES ACCELERATED BY ELECTROMAGNETIC WAVES IN A PLASMA WITH A SPATIALLY DECREASING DENSITY. Davydovskii, V.Ya.; Ukolov, A.S. (Taganrog Radiotechnical Institute). Sov. Phys.—Tech. Phys. 19: No. 10, 1303-1307 (Apr 1975).

The energies of charged particles trapped by an electromagnetic wave propagating in a plasma are found when the electron density decreases exponentially in the direction of propagation. It is shown that an adiabatic treatment, in which the wave velocity is a slowly varying function, is valid for the entire acceleration process. Two mechanisms are considered for the loss of particles from the trapped state: the reduction in the amplitude of the wave and collisions. In the latter case the shape of the energy spectrum coincides with the spectrum observed for cosmic rays. The existence of a lower limit of the spectrum is indicated. (auth)

14143 BOUNDARY EFFECTS ON $M=0,\pm1$ ALFVÉN WAVES IN A CYLINDRICAL, COLLISIONLESS PLASMA. Paoloni, F.J. (Department of Electrical Engineering, Texas Tech University, Lubbock, Texas 79409). Phys. Fluids 18: No. 6, 640-644 (June 1975).

The dispersion relations for Alfvén waves with $\exp(jm\theta)$ azimuthal dependency are calculated for a cylindrical, cold, collisionless plasma. If the electron inertia term is included in the dielectric tensor, then, in a bounded plasma, there are two transverse wavenumbers for each axial wavenumber. The phase velocities for $m=0$, ±1 fast and slow waves are calculated for different vacuum thicknesses between the uniform plasma and the metal walls. It is found that $m=0$ and -1 fast waves each experience a cutoff below a given frequency, but the $m=+1$ fast wave can propagate even at very low frequencies provided the vacuum layer is of sufficient thickness. The calculations are shown to agree with previously reported experimental results. (auth)

14144 FLUID DYNAMIC DAMPING OF ION ACOUSTIC WAVES. Schott, L. (Department of Physics, University of Saskatchewan, Saskatoon, Canada). Phys. Fluids 18: No. 6, 645-650 (June 1975).

Expressions are derived for the spatial damping rate of ion acoustic waves traveling through inhomogeneous plasmas enclosed in plane, cylindrical, or spherical surfaces. The waves are assumed to have the same symmetry as the plasma. The solutions are valid for wavelengths small compared with the size of the plasma and negligible Landau damping. Ionization of the gas by beam or plasma electrons and ion-neutral collisions are taken into account. The wave is more heavily damped when it travels from the plasma boundary to the center than vice versa. (auth)

14145 MAXIMIZATION IN THE DAMPING RATE OF THE ION ACOUSTIC WAVE IN A TWO-ION PLASMA. Nakamura, M.; Ito, M.; Nakamura, Y.; Itoh, T. (Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro-ku, Tokyo, Japan). Phys. Fluids 18: No. 6, 651-655 (June 1975).

The characteristics of dispersion and Landau damping of ion acoustic waves are experimentally investigated in an argon-helium plasma with varying ion composition ratio. The dispersion relations change continuously from the argon mode to the helium mode. The damping rate has a maximum when the ion number density ratio ($r = n_{He}/n_A + n_{He}$) is about 0.08. This maximum is attributed to the resonance of helium ions with the argon mode ion acoustic wave and is consistent with theoretical predictions. (auth)

14146 MODE CONVERSION AND HARMONIC GENERATION AT THE UPPER HYBRID LAYER IN TOROIDAL PLASMAS. Schuss, J.J.; Hosea, J.C. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 18: No. 6, 727-734 (June 1975).

The behavior of an extraordinary wave normally incident along a decreasing magnetic field gradient in a warm collisionless toroidal plasma is considered. Full electromagnetic Vlasov theory is used and the density gradient lengths are assumed to be much larger than all wavelengths. In the case for which the upper hybrid layer is accessible, it is shown that the incident wave almost completely converts into a backward Bernstein mode at the layer. The Bernstein mode then propagates until it is absorbed near the cyclotron layer. The second harmonic generated by this pump field is calculated, and its usefulness for poloidal magnetic field measurements in tokamaks is discussed. The theory is found to be in qualitative agreement with previous experimental results. (auth)

14147 EFFECTS OF ELECTRON ANGLE SCATTERING IN PLASMA WAVES. Koch, R.A.; Horton, W. Jr. (Fusion Research Center, Department of Physics, The University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 18: No. 7, 861-865 (July 1975).

The collisional contribution to the fluctuating number and current density are calculated from the linearized electron kinetic equation with a Lorentz collision operator. In the weakly collisional regimes of practical importance for low frequency drift, sound, and Alfvén waves, the dominant dissipative contribution is shown to arise from the low energy electrons that contribute a damping proportional to $(\omega\nu_e/k^2v_e^2)^{3/5}$. (auth)

14148 CONE RESONANCE EXCITED BY AN ALTERNATING POINT CHARGE IN A WARM MAGNETOPLASMA. Chasseriaux, J.M. (Groupe de Recherches Ionosphériques, Centre National de la Recherche Scientifique, 94100 Saint-Maur des Fossés, France). Phys. Fluids 18: No. 7, 866-870 (July 1975).

Using the quasi-static approximation, the potential created by an alternating point charge in a warm magnetoplasma is studied theoretically. The excitation frequency is assumed to be less than both the plasma frequency and the electron gyrofrequency. An approximate expression for the dispersion relation enables us to obtain an analytical result for the potential, which remains finite on the resonance cone, while an interference structure appears either inside or outside the cone, depending on the excitation frequency. (auth)

14149 PRECESSION OF HIGH-INTENSITY ELLIPTICALLY POLARIZED LIGHT IN A PLASMA. Katz, I.; Parks, D.E. (Systems, Science, and Software, La Jolla, California 92037); Rotenberg, M. Phys. Fluids 18: No. 7, 895-896 (July 1975).

It is found that the rotation of the polarization ellipse of long-wavelength intense elliptically polarized light in a cold neutral plasma can be described succinctly by the equations of classical mechanics. (auth)

14150 LOW FREQUENCY RESONANCE CONE STRUCTURE IN A WARM ANISOTROPIC PLASMA. Burrell, K.H. (California Institute of Technology, Pasadena, California 91125). Phys. Fluids 18: No. 7, 897-903 (July 1975).

Asymptotic analysis of the electrostatic Green's function for an antenna in a warm, anisotropic, nearly collisionless plasma reveals the presence of new resonance cone structures which exist in addition to the cold plasma resonance cone for frequencies below the lower hybrid frequency. These new cones, the ion acoustic resonance cones, occur for frequencies $0 \leqslant \omega \leqslant \min(\omega_{pi}, \omega_{ci})$ and $\max(\omega_{pi}, \omega_{ci}) \leqslant \omega \leqslant \omega_{lh}$; they exist only when the electron temperature is nonzero and are important when $T_i/T_e \ll 1$. The interference structure associated with this cone is quite sensitive to the ion temperature and could be the basis of an ion temperature diagnostic technique for plasmas that meet the conditions of the theoretical derivation: $T_i/T_e \ll 1$ and $\omega_{ci} \gg \omega_{pi}$. (auth)

14151 SOME EXPERIMENTAL STUDIES OF TRANSVERSE PLASMA SHOCK WAVES. Robertson, S.; Chen, Y. (Columbia University, New York, New York 10027). Phys. Fluids 18: No. 7, 917-918 (July 1975).

Experimental measurements of magnetic field compression, density compression, ion temperature, and two-dimensional flow effects have been made for strong shock waves propagating at 10–30 cm/μsec in 30–400 mTorr deuterium. The results are compared with theoretical predictions. (auth)

14152 AN ATTEMPT TO OBSERVE SCATTERING OF 2 MM WAVES FROM TOKAMAK PLASMAS. Motley, R.W.; Ernst, W.P. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 18: No. 7, 922-923 (July 1975).

No signals were observed in an experiment to detect the 120° scattering of 2.15 mm waves by ion wave turbulence in the ST tokamak. The upper limit to the scattering intensity was ~ 300 times the level expected from ordinary Thomson scattering. (auth)

14153 EXCITATION OF WAVES IN A BOUNDED PLASMA BY AN ELECTRON BEAM WITH TRANSCRITICAL INITIAL VELOCITY. Bakaĭ, A.S.; Krivulya, S.S.; Fedorchenko, V.D.; Muratov, V.I. (Physico-technical Institute, Ukrainian Academy of Sciences). JETP Lett. 21: No. 4, 101-102 (20 Feb 1975).

It was observed for the first time that the system "plasma + electron beam", with velocity larger than the maximum phase velocity of the wave in the system, becomes unstable at a certain finite external-signal amplitude. The experimentally obtained amplitudes at which the instability sets in are in good agreement with the theoretical ones. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 14098 and 14824.

14154 (COO-2147-13) MATERIALS TESTING AND REQUIREMENTS FOR THE ERDA NUCLEAR-POWERED ARTIFICIAL HEART. Technical Progress Report, July 15, 1974–May 1, 1975. Andrade, J. D.; Coleman, D. L.; Leigh, A.; Hufferd, W. L. (Utah Univ., Salt Lake City (USA). Coll. of Engineering). 1975. Contract E(11-1)-2147. 46p. (UTEC-75066). Dep. NTIS $5.50.

Progress on the materials research and development effort for the ERDA-sponsored nuclear-powered artificial heart program is presented. Progress made during the first three years on hydrogel grafting and biological studies is summarized. Progress during the fourth year on studies of implanted artificial hearts, development of albumin surfaces, and in vitro mechanical studies is presented. (RCK)

14155 (SC-PR-67-265) SANDIA LABORATORIES QUARTERLY REPORT. Space Isotope Power Program, January–March 1967. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1967. 68p. Dep. NTIS $6.50.

Declassified 23 Jun 1972.

Progress during Jan. to April 1967 in the development of SNAP-11, -19, -27, and -29 batteries for spacecraft power systems is reported. (LCL)

Facilities and Equipment

14156 (ORNL-SUB-3310-3) TEST REPORT ON EXPERIMENTAL STRESS ANALYSIS OF A 24 INCH DIAMETER TEE (ORNL T-13). Henley, D. R. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA). Nuclear Components Dept.). Mar 1975. 184p. (CENC-1189). Dep. NTIS $12.25.

For Oak Ridge National Lab, TN.

The experimental stress analysis and low cycle fatigue test of one 24 in. x 24 in. x 10 in. schedule 160 carbon steel, ANSI B16.9 tee performed by Combustion Engineering, Inc. are described. The tee was instrumented with 230 rectangular strain gage rosettes. Elastic data was obtained for 12 loading conditions consisting of internal pressure and orthogonal pure moments and orthogonal direct forces applied individually to the free branch and run ends of the tee. One of the run ends of the tee was "built in" throughout the test. All loads were applied through pipe extensions welded to the tee. The tee was tested to failure in a low cycle pressure fatigue test with a cyclic internal pressure between 100 psi and 7000 psi. A through-the-wall fatigue crack occurred at 15,084 cycles. Significant test results are summarized and compared with design values tabulated in the ASME Boiler and Pressure Vessel Code, Section III, 1971. (auth)

14157 ELECTRO-SLAG REMELTING OF HEAVY FORGED PIECES. Wahlster, M.; Schumann, R. Energ. Tech.; 25: No. 9, 238-241 (Sep 1973). (In German).

The growing need for heavier single forged pieces, especially in generators for nuclear power plants, cannot be met by conventional metallurgical processes. The electro-slag remelting process appears to fulfill the requirements of great homogeneity in large single pieces. The installation constructed at the Roechling-Burbach steel works for handling sizes up to 165 tons is described and the homogeneity of the pieces with diameters between 1000 and 2300 mm is emphasized. (JSR)

14158 MODERN LEAK TESTS OF STEAM GENERATORS. Meyer, H. J. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A. G., Nuernberg (F. R. Germany). Abt. fuer Qualitaetswesen). pp 122-135 of Reports: Power Plants 1974. Essen, F. R. Germany; VGB-Dampftechnik (1974). (In German).

From Congress power plants 1974. Annual meeting of the VGB; Dortmund, F. R. Germany (9 Jul 1974). With abstract.

Two methods of leak testing are described. For partial leak testing (liquid leakage test) adhesive penetrant oil is used which has a pronounced fluorescent action in ultraviolet light. If there is a leakage, the penetrant oil administered on one side of the furnace will leak out on the opposite side with a certain time delay. The penetration time and the luminous spot allow quantitative conclusions to be drawn as to the size of the leak. Ultrasonic microphones capable as contact or directional microphones of receiving the frequencies between 35 and 45 kHz which occur preferably as a consequence of leakages and converting them into quantitative readings of the sonic pressure or into audible sound, allow an integrating leak detection process to be carried out on the wall of the furnace. Test results obtained so far seem to indicate in general that ultrasonic leak testing will become a very important technique to be applied to many problems of leak testing, especially in the continuous control of large steam generators for early detection of steam leakages. (auth)

14159 A DEVICE FOR CLOSING A PRESSURIZED ENCLOSURE. (to Societe Creusot-Loire, 75 – Paris (France)). French Patent 2,210,257/D/. 7 Dec 1972. 7p. (In French).

The invention relates to a closing device for pressurized enclosures comprising a vessel and a cover applied against each other along laterally outwardly directed flanges provided on the edges of the vessel and of the cover, the flanges being tightened against each other by means of a plurality of clamping rods resting by the ends thereof on the faces of the flanges. The clamping rods are distributed on the outer periphery along the lateral faces of the flanges and each end of these rods rests on the face of a flange on the one hand and on the corresponding edge of a reaction ring surrounding the outer periphery of the whole set of clamping rods on the other hand, the height of that ring being substantially equal to the spacing between the axially outer faces of the two flanges when the latter are applied against each other. The device can be used for closing all pressurized containers such as sterilizers, reactor vessels, etc. (FR)

14160 REMOTE-CONTROLLED APPARATUS FOR EFFECTING AN ANNULAR CUTTING, PARTICULARLY IN TUBES DISPOSED OVER A NUCLEAR REACTOR VESSEL. Leshem, A. (to Combustion Engineering, Inc., New York (USA)). French Patent 2,211,313/A/. 20 Dec 1973. 31p. (In French).

A remote-controlled apparatus to perform annular cutting, particularly in tubes raised above a reactor vessel, is described. The apparatus consists of an envelope for sliding longitudinally over hard-to-get-at pieces and surrounding them. Support and stopping elements arrest the movement of the envelope automatically in a predetermined operating position in which the cutting can be made. A sleeve placed at the interior of the envelope can be rotated from outside but it cannot be placed longitudinally and it supports the cutting tool and its positioning and communicating elements. The apparatus is applicable to the cutting of long tubular pieces screwed together, particularly welds closing an oval seam between such elements as the tubes raised above a reactor vessel. (tr-FR)

14161 THE MECHANICS OF PRESSURE VESSELS. Relationships with the Problem of Materials. Labbens, R. (Societe Creusot-Loire, 75 – Paris (France)). Rev. Metall. (Paris).; 72: No. 1, 1-37 (Jan 1975). (In French).

The various types of damages leading to the destruction of pressure vessels are reviewed: excessive deformation, plastic instability, fatigue cracking, abrupt failure and creep failure. The recent developments in elasticity, plasticity and fracture mechanics are presented. (FR)

Lasers

Refer also to abstracts 14004 and 15510.

14162 (AERE-R-7939) PERFORMANCE SIMULATIONS OF AN HCl CHEMICAL CONTINUOUS-WAVE LASER. Curtis, A. R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1975. 77p. Dep. NTIS (US Sales Only) $7.00. UK pounds 1.50.

Quantitative simulations are reported of an H_2 and Cl_2 continuous wave chemical laser, with full treatment of the Einstein equations describing radiative interaction with 105 vibration-rotation lines in five HCl vibrational bands, as well as of the chemistry and thermodynamics for constant-pressure conditions. (auth)

14163 (LA-UR-75-758) SUPERCONDUCTIVITY, ENERGY STORAGE AND SWITCHING. Laquer, H. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 27p. (CONF-741113-11). Dep. NTIS $4.50.

From international conference on energy storage, compression and switching; Turin, Italy (5 Nov 1974).

The phenomena of superconductivity can contribute to the technology of energy storage and switching in two distinct ways. On one hand the zero resistivity of the superconductor can produce essentially infinite time constants so that an inductive storage system can be charged from very low power sources. On the other hand, the recovery of finite resistivity in a normal-going supercon-

ducting switch can take place in extremely short times, so that a system can be made to deliver energy at a very high power level. Topics reviewed include: physics of superconductivity, limits to switching speed of superconductors, physical and engineering properties of superconducting materials and assemblies, switching methods, load impedance considerations, refrigeration economics, limitations imposed by present day and near term technology, performance of existing and planned energy storage systems, and a comparison with some alternative methods of storing and switching energy. (auth)

14164 (N-74-34011) VARIABLE CO^2 LASER ATTENUATOR. Klein, B. J.; Degnan, J. J.; Walker, H. E.; Zagwodzki, T. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Aug 1974. 37p. (NASA-TM-X-70753; X-723-74-243). NTIS $5.00.

An infrared wavelength variable attenuator based on contra-rotating germanium wedges is examined theoretically. The device redirects the paths of internal reflections associated with an optical flat to avoid closely spaced parallel beams at the output. Complementary wedges separated by an air gap compose an optical flat which, when combined with a masking arrangement, restrict unwanted reflections. A model of the device was built and experimentally evaluated. The results compare favorably with the dynamic range of attenuation of 2 to 50 db from theoretical calculations, and show a substantial reduction in the etalon effect associated with pairs of optical flats. (auth) (STAR)

14165 (SAND-75-0258) LASER AMPLIFIER MECHANICAL SYSTEM. Mastin, F. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1975. Contract AT(29-1)-789. 46p. Dep. NTIS $5.50.

The design of the mechanical system for the iodide laser amplifier is reported. This work was done in support of the Laser Physics Research Department, 5210. Included is a full description of the mechanical system along with drawings showing fabrication details. (auth)

14166 (SAND-75-5591) SOFT X-RAY LASERS PUMPED BY PHOTOIONIZATION. Duguay, M. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 30p. (CONF-750634-1). Dep. NTIS $4.50.

From conference on the physics of quantum electronics; Santa Fe, New Mexico, USA (23 Jun 1975).

One of the methods that has been proposed to pump an x-ray laser is based on the use of photoionization to selectively populate certain inner-shell vacancy states. Only time will tell how practical this method is. In the meantime, the photoionization scheme at least offers the advantage of being one where the pumping requirements are calculable in a straightforward way. Calculations on a few typical examples are presented. Progress that has been made at the experimental level is briefly reported. (auth)

14167 (UCRL-76530(Rev.1)) X-RAY AND GAMMA-RAY LASERS. Chapline, G.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1975. 14p. (CONF-750632-1). Dep. NTIS $4.00.

From 4th Vavilov conference; Novosibirsk, USSR (12 Jun 1975).

The prospects and difficulties of producing coherent electromagnetic radiation at wavelengths less than 10 A are discussed. (TFD)

14168 (Y-DA-6200) BLUR-CIRCLE MEASUREMENTS ON A HIGH-ENERGY LASER MIRROR. Sladky, F. E.; Dean, R. H. (Oak Ridge Y-12 Plant, Tenn. (USA)). 27 Jun 1975. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

The purpose of the system of diamond-turned mirrors for the high-energy carbon dioxide laser is to concentrate the light energy into a spot less than one millimetre in diameter. A collimating and a focusing mirror for the system were illuminated with the expanded beam of a helium/neon laser to measure the size of the focal spot (blur circle), using visible light. The diameter of the blur circle was found to be approximately 0.6 mm (0.024 in) in diameter. (auth)

14169 TEMPERATURE RISE IN A SUPERCONDUCTING CABLE DURING OVERLOAD. Melville, P. H. (Central Electricity Research Labs., Leatherhead, Eng.). Cryogenics; 15: No. 5, 265-269(May 1975).

Approximate calculations are presented for the temperature rise and temperature fluctuation in an ac superconducting cable during current overload. The calculations are for a cable, which it is intended will remain superconducting throughout the overload. These show that because of the low value of T_c and low J_c niobium-titanium is not a suitable material to use. Niobium-zirconium with a 1 mm copper backing will carry continuous overloads of up to x 9 and a first cycle overload of up to x 11 provided it is fully stabilized against flux jumps. (Normal surface current rating = 4×10^4 A m^{-1}). Niobium-tin can in principle carry very large overloads, but the limiting factors are its poor mechanical properties, the difficulty in producing thick layers of the material, and stabilization. (auth)

14170 PROPERTIES OF STRONGLY NON-EQUILIBRIUM FLOW IN POPULATION INVERSION IN SHOCK WAVES. Kuznetsov, V. M. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 30-33(1975). (In Russian).

The effect of the parameters of the leading current and of the percent composition of the laser mixture $CO_2 + N_2 + H_2O(He)$ on the population inversion in the relaxation zone of a direct shock wave was examined. (tr-auth)

14171 QUASI-STEADY POPULATION REGIME OF CO_2 LASERS EXCITED BY NON SELF-MAINTAINED DISCHARGE. Vedernikov, G. A.; Karnyushin, V. N.; Soloukhin, R. I. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 3-12(1975). (In Russian).

In the framework of a comparatively simple model the dynamic operation of CO_2 lasers during excitation by non-self-maintained discharges was studied. The parameters for a quasi-steady population operation were determined for a wide range of controlled conditions. (tr-auth)

14172 CONTINUOUS GENERATION OF CaF_2-Dy^{2+} LASERS WITH SEMISPHERICAL RESONATOR. Isaev, S. K.; Kornienko, L. S.; Lariontsev, E. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 6, 752-754(1974). (In Russian).

A detailed study is made of the relation of the kinetics of generation with the parameters of the generator and mode structure of the radiation of a Dy laser. It is shown that the resonator parameters have a substantial effect on the kinetics of continuous generation. The non-fading pulsation of the radiation in all mode studies is probably determined by the instabilities of the laser parameters. One of the basic results is obtaining almost even, practically single-frequency generation during excitation of the TEM_{00} mode with the admixture of a weak transverse low-order mode. (JSR)

14173 AMPLIFICATION IN A RECOMBINING PLASMA (PLASMA LASERS). Gudzenko, L. I.; Shelepin, L. A.; Yakovlenko, S. I. (Lebedev Inst. of Physics). Usp. Fiz. Nauk; 114: No. 3, 457-485(Nov 1974). (In Russian).

Studies are reviewed dealing with lasers, the amplifying medium of which is an intensely recombining (supercooled with respect to the free electrons) dense plasma. Effective amplification of the radiation in the visible and ultraviolet regions is possible at $N_e = 10^{13}$ to 10^{18} cm^{-3}, $T_e = 0.05$ to 2 eV, where N_e is the density of free plasma electrons and T_e is their temperature. On going to short wavelengths and high energies, plasma lasers have substantial advantages in comparison with traditional gas lasers, the active medium of which is an ionized (superheated) plasma of a gas-discharge type. The purpose of this review is to describe the already noted tendency towards developing plasma lasers. Attention is devoted to recombination mechanisms for creating an inversion population of atoms, ions and molecules, methods of obtaining a supercooled plasma, and also to features of different variants of plasma lasers. General features of the theory are illustrated by numerical calculations and experimental data. (78 references) (SJR)

14174 GASDYNAMIC LASERS. Russell, D. A. (Univ. of Washington, Seattle). Astronaut. Aeronaut.; 13: No. 6, 50-55(Jun 1975).

This article reviews the basic idea of the gasdynamic laser--population inversion in a fast-moving gas through a nonequilibrium expansion--examines gasdynamic-laser technology, and offers a prognosis of the exciting future ahead. (auth)

14175 PULSE PRISM LASER Q-SWITCH. Stamenov; Vasilev, Ya.; Yordanova, Zh.; Pavlov, L. (Sofia Univ.). God. Sofii. Univ., Fiz. Fak.; 64-65; 289-293(1973). (In Bulgarian).

The disadvantages of conventional modulators with rotating prisms are discussed. The disadvantages include the difficulty of stabilizing the speed of rotation of the prism; sensitivity of the mechanical part to shaking; complexity of synchronizing the operation of the modulated laser with other types of lasers, etc. A new modulator is proposed in which continuous rotation of a prism with total internal reflection is replaced by high-speed rotation through a limited angle with transition through the working position. Different methods of prism rotation are indicated. (Ref. Zh.)

14176 MODE-LOCKING OF TWO SOLID-STATE LASERS UNDER UNSTEADY LASING CONDITIONS. Golubeva, N. S.; Kozintsev, V. I.; Rozhdestvin, V. N.; Lebedenko, V. P. Izv. Vyssh. Ucheb. Zaved., Radioelektron.; 17: 25-30(Sep 1974). (In Russian).

Consideration of the process of mode-locking two coupled single-frequency lasers with allowance for unsteadiness of their fields under peak operating conditions. The behavior of this system under unsteady operating conditions is investigated on the basis of the quasi-classical theory of lasers. A numerical analysis is made of the rate of entry into the mode-locked state in a wide range of change in the mutual mismatch of the lasers, the gain coupling coefficients, and the losses. (Int. Aerosp. Abstr.)

14177 SELF-FOCUSING OF VERY POWERFUL LASER BEAMS. II. Suydam, B. R. (Univ. of California, Los Alamos, NM). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-10: 837-843(Nov 1974).

The investigation reported is concerned with the removal of a constraint which restricts the theory of self-focusing of very intense laser beams proposed by Suydam (1973) to a plane wave of infinite aperture. The effects of initial beam convergence or divergence and of finite aperture are examined. A comparison is conducted of instability and of total collapse theories. (Int. Aerosp. Abstr)

14178 INTRODUCTION TO GAS LASERS: POPULATION INVERSION MECHANISMS WITH EMPHASIS ON SELECTIVE EXCITATION PROCESSES. Willett, C. S. International Series of Monographs in Natural Philosophy. Vol. 67. New York; Pergamon Press (1974). 542p. $45.00.

The historical development and basic principles of gas lasers are examined, giving attention to a chronology of major advances, fundamental processes, the interaction of radiation with matter, and oscillation conditions. Selective excitation processes in gas discharges are considered along with gas discharge processes, specific neutral laser systems, and specific ionized laser systems. Specific molecular laser systems are also discussed, taking into account resonant excitation-energy transfer lasers, electron-impact-excited lasers, line absorption lasers, and radiative cascade lasers. (Int. Aerosp. Abstr.)

14179 MECHANISM OF POPULATING THE STATES $5s^2\ ^2D_{3/2,5/2}$ ($^2D^*$) OF THE CADMIUM IONS IN A He-Cd LASER. Semenova, O. P.; Elaev, V. F. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 143-145(1975). (In Russian).

Another possible mechanism of populating the $^2D^*$ states of Cd ions, which can assure continuous generation, is the cascade population from higher excited states which are excited in the discharge by charge transfer of Cd atoms on He ions. An analysis of the energy levels of Cd^+ shows that charge transfer can effectively populate a large number of excited states of Cd ions, and spontaneous transfers from these states can directly or through intermediate states populate the $^2D^*$ states. Measurement of the absolute intensities of spectral lines showed that it is necessary to take into account the population of $^2D^*$ states of Cd ions by cascade transitions. (SJR)

14180 SCREEN NOZZLES FOR GASDYNAMIC LASERS. Russell, D. A.; Neice, S. E.; Rose, P. H. (Mathematical Sciences Northwest, Inc., Seattle). AIAA (Am. Inst. Aeronaut. Astronaut.) J.; 13: No. 5, 593-599(May 1975).

From 7th fluid and plasma dynamics conference; Palo Alto, CA (17 Jun 1974).

Fine-hole orifice plates (screen nozzles) are considered as a replacement for two-dimensional grid nozzles in gasdynamic lasers. Analyses are made of the downstream fully mixed state, the flow perturbation decay to that state, and the optical gain distribution for typical N_2-CO_2 laser conditions. Experiments were conducted with a screen nozzle mounted on a shock tube. Density nonuniformities were found to be below 1 percent at 100 orifice spacings downstream (30 cm), with gains of 0.6–0.8 percent/cm. These results agree with predictions and lead to the conclusion that screen nozzles offer extreme simplicity with only small performance penalty. (auth)

14181 EFFECTS OF TURBULENCE ON A WEAKLY IONIZED PLASMA COLUMN. Shwartz, J.; Lavie, Y. (Israel Inst. of Tech., Haifa). AIAA (Am. Inst. Aeronaut. Astronaut.) J.; 13: No. 5, 647-652(May 1975).

From 7th fluid and plasma dynamics conference; Palo Alto, CA (17 Jun 1974).

A theoretical model for predicting the effects of turbulent flow on properties of the positive column in a glow discharge is presented. The model assumes that the ions which are imbedded in the turbulent neutral gas flow acquire the motion of, and are completely correlated with, the neutral gas. Available models for a turbulent pipe-flow and for the positive column of a glow discharge are then combined to derive the effect of turbulence on ambipolar diffusion, rate of ionization, electric field, electron temperature, and charge distribution. The model predicts that an increase in the Reynolds number of the flow will increase the ionization rate, the electron temperature, and the electric field, and will flatten out the charge-concentration profiles in agreement with past observations and with our own experimental results. (auth)

14182 RELIABILITY ASPECTS AND FACET DAMAGE IN HIGH-POWER EMISSION FROM (AlGa)As CW LASER DIODES AT ROOM TEMPERATURE. Kressel, H.; Ladany, I. (RCA Labs., Princeton, NJ). RCA Rev.; 36: No. 2, 230-239(Jun 1975).

Factors are described that limit the optical power output from (AlGa)As laser diodes (lambda equals 8100 to 8300 A) operating cw at room temperature with uncoated facets. Rapid laser "catastrophic" degradation due to facet damage (in contrast to "bulk" phenomena previously considered) has been found to occur as a result of excessive optical flux density at the facets. The diodes studied are capable of initial cw power emission values of 25 to 100 mW from one facet depending on their dimensions. Data are presented showing long-term constant-current operation at power levels below these maximum values. Preliminary data are also presented on devices utilizing dielectric facet coatings to minimize facet damage. (auth)

14183 LIQUID PHASE EPITAXIAL $In_{1-x}Ga_xP(x\sim0.63)$ JUNCTION LASER IN THE YELLOW SPECTRAL REGION ($\lambda\sim5900$ Å, 2.10 eV, 77°K). Hitchens, W.R.; Holonyak, N. Jr.; Lee, M.H.; Campbell, J.C. (Department of Electrical Engineering and Materials Research Laboratory). Sov. Phys.—Semicond. 8: No. 12, 1575-1578 (June 1975).

Laser operation (77°K) of liquid phase epitaxial (LPE)$In_{1-x}Ga_xP$ p-n junctions is demonstrated at $\lambda\sim5900$ A. The constant-temperature liquid phase epitaxial (CT-LPE) growth method used in the synthesis of the crystals is described briefly. The junctions were prepared by the sequential growth (on $GaAs_{1-y}P_y$ substrates) of first an n-type layer and then a Zn-doped p-type layer (not compensated). During the growth of the p-type layer, Zn diffused slightly (at reduced concentrations) into the first layer yielding a thin p-type compensated active layer. Photoexcitation of the active region of the junction showed that the recombination radiation was confined to the compensated region and was lower in energy than the photoemission of either the n- or p-type layer. The waveguiding effect in the active layer and the donor band-tail structure in the compensated region of the junction indicated that the structure approximated the operational behavior of a single heterojunction. Although the threshold for the laser operation of these devices was high, it was demonstrated, nevertheless, that a III-V semiconductor junction can operate as a laser at wavelengths λ—5900 Å, or into the yellow. It is argued that $In_{1-x}Ga_xP$ will operate as a junction laser (77°K) to perhaps ~5650 Å. (auth)

14184 ROTATIONAL NONEQUILIBRIUM IN CW CHEMICAL LASERS. Sentman, L. H. (Univ. of Illinois, Urbana). J. Chem. Phys.; 62: No. 9, 3523-3537(1 May 1975).

By including the spontaneous emission term in the radiative transfer equation, an explicit expression for the radiation term in the species equation is obtained in terms of the fluid variables. This formulation is used to study the role of rotational nonequilibrium in cw chemical lasers. It is shown that the phenomena of J shifting and the power being contained in the high J transitions are consequences of the rotational equilibrium assumption. When rotational nonequilibrium is allowed to occur, several J transitions within a given vibrational band lase simultaneously, most of the power is contained in those J transitions that are preferentially populated by the pumping reaction, and the power is decreased by 20 to 30 percent from the rotational equilibrium value. Agreement between the predicted and observed lasing transitions in HF lasers is obtained. (auth)

14185 INTRACAVITY MODULATION OF A LOW-GAIN THREE-MIRROR GAS LASER. Dianova, V. A.; Mustel, E. R. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 6, 70-73(Jun 1974).

Translated from Radiotekh. Elektron.; 19: No. 6, 1227-1231 (Jun 1974).

Internal modulation of a low-gain three-mirror laser is considered theoretically, taking into account the losses in the modulating element. It is shown that for specified losses in the modulator there is an optimum reflectance for the auxiliary mirror. The three-mirror system has been tested experimentally, confirming the theoretical conclusions. (auth)

14186 EFFICIENT FREQUENCY DOUBLER OF NEODYMIUM LASER RADIATION, EMPLOYING A MOLECULAR CRYSTAL OF METANITROANILINE. Davydov, B. L.; Koreneva, L. G.; Lavrovskii, E. A. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 6, 130-131(Jun 1974).

Translated from Radiotekh. Elektron.; 19: No. 6, 1313-1315 (Jun 1974).

The properties of metanitroaniline crystals and their performance for doubling and conversion of the frequency of neodymium laser radiation are discussed. (TFD)

14187 PARTICULARS OF EMISSION OF A RUBY LASER WITH KS-19 GLASS SHUTTER IN THE PULSE-REPETITION MODE. Andreichev, V. A.; Korochkin, L. S.; Mikhnov, S. A. Zh. Prikl. Spektrosk.; 21: No. 3, 451-455(1974). (In Russian).

An investigation is made of the energy parameters of a monopulse ruby laser with a solid-state KS-19 glass shutter operating in the pulse-repetition mode. It is shown that in contrast to liquid shutters, the heat release in the KS-19 glass in the periodic mode of laser emission leads to a rise of energy emitted in the monopulse, followed by emission cutoff. A laser optical system is proposed which appreciably reduces the influence of heat release in a solid-state passive shutter. (Ref. Zh.)

14188 THEORY OF MODE LOCKING WITH A FAST SATURABLE ABSORBER. Haus, H.A. (Bell Laboratories, Holmdel, New Jersey 07733). J. Appl. Phys. 46: No. 7, 3049-3058 (July 1975).

This paper presents a closed-form analysis of saturable absorber mode locking of a homogeneously broadened laser. A solution is obtained for the case of a short relaxation time of the saturable absorber. This pulse is a hyperbolic secant as a function of time. For each choice of parameters two pulse widths are found. A stability analysis shows that the solution of greater width is stable. The requirements for achieving mode locking with a fast saturable absorber are stated. The effect of a time-varying laser medium gain is investigated analytically. (auth)

14189 OPTICAL EMISSIONS FROM E-BEAM-EXCITED GAS MIXTURES. Gutcheck, R.A.; Hill, R.M.; Lorents, D.C.; Huestis, D.L.; McCusker, M.V.; Nakano, H.H. (Molecular Physics Center, Stanford Research Institute, Menlo Park, California 94025). J. Appl. Phys. 46: No. 7, 3106-3108 (July 1975).

A high-energy electron beam has been used to pump mixtures of rare gases and atmospheric gases or metal vapors. Bright optical emissions have been produced, and a table is given listing both the observed transitions and their relative intensities. (auth)

14190 BROADLY TUNABLE LASERS USING COLOR CENTERS. Mollenauer, L.F.; Olson, D.H. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). J. Appl. Phys. 46: No. 7, 3109-3118 (July 1975).

The potential of certain color centers to make efficient broadly tunable cw lasers for the infrared is discussed. We show how the range $0.9 \lesssim \lambda \lesssim 3.3$ μm can be covered by using F_A(II), F_B(II) and F^{+2} centers. The pertinent physics of these centers is reviewed and appropriate laser cavity configurations are discussed. The construction and performance of an advanced F_A(II) laser is reported. Finally, the possible use of color centers in distributed feedback devices is discussed. (auth)

14191 NONLINEAR STABILITY OF SPIN-FLIP EXCITATIONS. Arunasalam, V. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). J. Appl. Phys. 46: No. 7, 3119-3125 (July 1975).

A rather complete discussion of the nonlinear electrodynamic behavior of a negative-temperature spin system is presented. The method presented here is based on a coupled set of master equations, one describing the time evolution of the photon (i.e., the spin-flip excitation) distribution function and the other describing the time evolution of the particle distribution function. It is found that the initially unstable (i.e., growing) spin-flip excitations grow to such a large amplitude that their nonlinear reaction on the particle distribution function becomes important. It is then shown that the initially totally inverted two-level spin system evolves rapidly (through this nonlinear photon-particle coupling) towards a quasilinear steady state where the populations of the spin-up and the spin-down states are equal to each other. Explicit expressions for the time taken to reach this quasilinear steady state and the energy in the spin-flip excitations at this state are also presented. (auth)

14192 THRESHOLD TEMPERATURE CHARACTERISTICS OF DOUBLE HETEROSTRUCTURE $Ga_{1-x}Al_xAs$ LASERS. Goodwin, A.R.; Peters, J.R.; Pion, M.; Thompson, G.H.B.; Whiteaway, J.E.A. (Standard Telecommunication Laboratories Limited, London Road, Harlow, Essex CM17 9NA, England). J. Appl. Phys. 46: No. 7, 3126-3131 (July 1975).

The variation with temperature of laser threshold current density under pulsed operation conditions, J_t, has been measured for double heterostructure wafers grown with a range of values of heterojunction step height Δx. Good correlation is found between Δx and the temperature coefficient which is defined as the ratio of the values of J_t at 65 and 10 °C. Values of J_{65}/J_{10} are found to be approximately 1.5 for $\Delta x = 0.30$, increasing slowly to 2.0 at $\Delta x = 0.20$ and increasing very rapidly for smaller values of Δx. This behavior is interpreted as arising from leakage of electrons from the active region into the *p* passive layer. A theoretical model of carrier leakage confirms the interpretation in that quantitative agreement with experiment was obtained using reasonable values for the disposable parameters of carrier lifetime and mobility. The model is used to predict approximate limits to the Al concentrations in the passive layers needed for stable continuous laser operation over a wide temperature range. (auth)

14193 INTENSE SOFT UV EMISSION FROM COAXIAL-GEOMETRY ARC SOURCES IN HELIUM. Beverly III, R.E. (Battelle, Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201). J. Appl. Phys. 46: No. 7, 3203-3204 (July 1975).

Intense soft uv radiation (~2700 A) has been experimentally produced by coaxial-geometry ceramic-surface arc discharges in high-pressure helium. Arc sources may have significant advantages for the excitation of photodissociation lasers such as the iodine system. (auth)

14194 CO_2 OSCILLATOR–PULSE SHAPER–AMPLIFIER SYSTEM PRODUCING 0.1 J IN A 500 PSEC LASER PULSE. Kwok, H.; Yablonovitch, E. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138). Rev. Sci. Instrum. 46: No. 7, 814-816 (July 1975).

The output of an optical free induction decay pulse generator was amplified up to the 0.1 J level. A pulse width of 500 psec was resolved on a Tektronix 519 oscilloscope using a pyroelectric detector. This agreed well with a linear computer model of the system response. (auth)

14195 DOPED CO_2 TEA LASER. Reits, B.J.; Olbertz, A.H.M. (Physics Department, Twente University of Technology, Enschede, The Netherlands). Appl. Phys. Lett. 27: No. 1, 24-25 (1 July 1975).

An extremely weak uv source conditions a large CO_2 laser gas discharge with the aid of the seed gas tri-*n*-propylamine. With roughened Rogowski-shaped electrodes a glow discharge is achieved without a uv source. Evidence exists that the seed gas plays a role in the gas discharge itself. (auth)

14196 FAST FREQUENCY STABILIZATION OF A CW DYE LASER. Barger, R.L.; West, J.B. (Time and Frequency Division, National Bureau of Standards, Boulder, Colorado 80302); English, T.C. Appl. Phys. Lett. 27: No. 1, 31-33 (1 July 1975).

A system is described for stabilizing a cw dye laser frequency to a high-finesse optical cavity. The length of this optical cavity is locked to a CH_4-stabilized He-Ne laser with a tunable frequency-offset technique. A very fast servo system (using an intracavity KD*P crystal), a long dye laser cavity, and the stabilized optical cavity result in an absolute frequency stability of 1 kHz for an integration time of 10^{-4} sec and 300 Hz for 300 sec. Intensity is stabilized to one part in 10^4. (auth)

14197 GaAs-$Al_xGa_{1-x}As$ INJECTION LASERS WITH DISTRIBUTED BRAGG REFLECTORS. Reinhart, F.K.; Logan, R.A. (Bell Laboratories, Murray Hill, New Jersey 07974); Shank, C.V. Appl. Phys. Lett. 27: No. 1, 45-48 (1 July 1975).

Room-temperature operation of an optically integrated double heterostructure (DH) GaAs-$Al_xGa_{1-x}As$ injection laser with a distributed Bragg reflector (DBR), with threshold current densities of 5 kA/cm² is reported. The DBR was in the form of a third-order grating which was ion milled on a passive single heterostructure (SH) waveguide section with the latter taper coupled to the active DH section. The observed half-power spectral bandwidth was $\lesssim 1$ Å. A highly collimated beam output with a half-power divergence angle of $\lesssim 0.3°$ was also achieved by coupling the scattered light from the oil-immersed grating at the Bragg angle with a prism. (auth)

14198 A SCHEME OF CHEMICAL PLASMA LASER. Goodzenko, L. I.; Yakovlenko, S. I.; Yevstigneev, V. V. (AN SSSR, Moscow. Fizicheskij Inst.). Phys. Lett., A; 53: No. 1, 105-106 (19 May 1975).

In case of intense recombination in a dense plasma of complex chemical composition, high rate chemical reactions can clean out the ground states of atoms and slightly affect the population of excited states. A scheme of amplification of the resonance emission of atom Tl is proposed. (auth)

14199 THE TEMPORAL STRUCTURE OF THE RADIATION OF PULSED SEMICONDUCTOR INJECTION LASERS. Deryagin, V.N.; Marasin, L.E.; Popov, Yu.V.; Portnoi, E.L. Sov. J. Opt. Technol. 41: No. 8, 429-431 (Aug 1974).

The results of a study of the temporal structure of the near radiation field of different types of semiconductor lasers are presented, and a mechanism is proposed for its formation. It is shown that the spatial–temporal nonuniformity of the near radiation field of heterolasers in the $Al_xGa_{1-x}As$–GaAs–$Al_xGa_{1-x}As$ system is about an order of magnitude less than for semiconductor lasers employing diffused p–n junctions and unilateral heterostructures. (auth)

14200 HOMOGENEOUSLY BROADENED REGIMES OF A RING LASER WITH ADDITIONAL FEEDBACK. Rozanov, N.N. Opt. Spectrosc. (USSR) 38: No. 2, 189-192 (Feb 1975).

Stationary regimes and transition processes in a ring laser with additional feedback are studied. The case of homogeneous broadening was considered within the framework of the Lamb theory, but without using the weak-field approximation. The soft nature of excitation of the single traveling-wave regime and hard excitation of the two-wave regime are established for an important special case. The effect of Q difference for the two directions which exists in a resonator with a nonreciprocal element, is studied. The existence of two regimes (unidirectional and two-wave) in a ring laser with an additional mirror is also shown in the linear approximation, neglecting back scattering. (auth)

14201 INFLUENCE OF ADMIXTURES ON THE GAIN OF A GASDYNAMIC CARBON DIOXIDE LASER. Britan, A.B.; Losev, S.A.; Shatalov, O.P. (Institute of Mechanics, M. V. Lomonosov Moscow State University). Sov. J. Quantum Electron. 4: No. 12, 1459-1460 (June 1975).

A shock tube with an internal diameter of 500 mm and a planar 30° nozzle at one end was used in a study of the influence of O_2, H_2, CO, H_2O, C_2H_2, and C_2H_4 admixtures on the gain of a 15% CO_2+83% N_2+2% H_2O gasdynamic laser. The pressure of the active mixture in the entry plane of the nozzle was 5.3 atm and its temperature was 1790°K. It was found that the addition of diatomic molecules in amounts up to 10–14% had little influence on the measured gain. Polyatomic molecules had a stronger influence (they reduced the gain) but throughout the investigated range of the admixtures (up to 16%) the gain was still positive. (auth)

14202 INFLUENCE OF THE CONDENSATION OF A GAS ON THE RATES OF RELAXATION PROCESSES IN GASDYNAMIC LASERS. Konyukhov, V.K.; Faizulaev, V.N. (P. N. Lebedev Physics Institute, USSR Academy of Sciences, Moscow). Sov. J. Quantum Electron. 4: No. 12, 1461-1462 (June 1975).

An analysis is made of possible mechanisms of the surface relaxation of the vibrational energy of molecules. These mechanisms are responsible for the condensation-induced acceleration of the relaxation processes in gasdynamic lasers. (auth)

14203 MEASUREMENT OF THE SPATIAL COHERENCE OF CO_2 LASER RADIATION BY THE FREQUENCY UP-CONVERSION METHOD. Gordienko, V.M.; Chernega, P.I. (M. V. Lomonosov Moscow State University). Sov. J. Quantum Electron. 4: No. 12, 1477-1478 (June 1975).

A polarizing interferometer and a photomultiplier operated as a photon counter were used in measurements of the spatial correlation function of the radiation field of a CO_2 laser, which was up-converted from the infrared range in a proustite crystal. The proposed method made it possible to use a low-power He–Ne laser as a pump source in parametric conversion and to make high-precision measurements. (auth)

14204 RING GAS LASER WITH A STRONG COUPLING BETWEEN TRAVELING WAVES. Belenov, E.M.; Danileiko, M.V.; Kozubovskii, V.R.; Nedavnii, A.P.; Nikolaenko, A.N.; Shpak, M.T. (P. N. Lebedev Physics Institute, USSR Academy of Sciences, Moscow Institute of Physics, Ukrainian SSR Academy of Sciences, Kiev). Sov. J. Quantum Electron. 4: No. 12, 1479-1480 (June 1975).

A theoretical analysis is made of the operation of a single-mode ring gas laser with a strong coupling between traveling waves as a result of back reflections. It is shown that when the coupling coefficient exceeds a certain critical value, a spontaneous oscillatory energy transfer from one wave to the other and back again is observed at the centers of the gain and absorption profiles. Under certain conditions this may give rise to extremely narrow power resonances characterized by a 100% contrast. (auth)

14205 CALCULATION OF SOME CHARACTERISTICS OF A CW CARBON DIOXIDE LASER WITH A NON-SELF-MAINTAINED DISCHARGE. Babaev, I. K.; Blinov, N. A.; Dolgov-Savel'ev, G. G.; Orlov, V. K.; Savel'ev, V. V. Sov. J. Quant. Electron.; 4: No. 12, 1483-1484(Jun 1975).

14206 MINIATURE LASER AND ITS COUPLING TO A THIN-FLIM OPTICAL WAVEGUIDE. Zienko, A.A.; Prokhorov, A.M.; Sychugov, V.A.; Shipulo, G.P. (P. N. Lebedev Physics Institute, USSR Academy of Sciences, Moscow). Sov. J. Quantum Electron. 4: No. 12, 1430-1432 (June 1975).

A theoretical analysis is given of possible methods for coupling a miniature semiconductor or solid state laser to a thin-film dielectric waveguide. The results are given of an experimental study of the tunnel coupling of the radiation emitted by a YAG:Nd laser into a film. It is shown that unidirectional propagation of light in a film waveguide can be achieved under optimal coupling conditions. (auth)

14207 INVESTIGATION OF THE DISCHARGE STABILITY AND FREQUENCY CHARACTERISTICS OF REACTIVE OSCILLATIONS IN HELIUM-NEON LASERS WITH SMALL-DIAMETER TUBES. Zakharenko, Yu.G.; Pokrovskii, E.N.; Privalov, V.E. (D. I. Mendeleev All-Union Scientific-Research Institute of Metrology, Leningrad). Sov. J. Quantum Electron. 4: No. 12, 1433-1435 (June 1975).

A linearized equation, describing the behavior of a discharge in the case of weak perturbations, is derived. An expression for the harmonic stage of reactive oscillations is obtained using the external circuit equation. The stability conditions in a He–Ne laser discharge are analyzed. Equations are obtained for the maximum stable discharge current and for the harmonic stage frequency. The results of this analysis are compared with experiments carried out on OKG-13, OKG-16, and LG-56 tubes. (auth)

14208 BREAKDOWN OF THE ACTIVE MEDIUM IN A CO_2 LASER CAUSED BY ITS OWN RADIATION. Lobanov, A.N.; Suchkov, A.F. (P. N. Lebedev Physics Institute, USSR Academy of Sciences, Moscow). Sov. J. Quantum Electron. 4: No. 12, 1436-1438 (June 1975).

Pressure dependences of the breakdown energy density are calculated numerically for N_2 and CO_2, and for N_2+CO_2+He mixtures subjected to pulses of different duration. The influence of a static field on the breakdown threshold is investigated. It is shown that the output energy approaches saturation below the breakdown value. (auth)

14209 SELF-OSCILLATORY REGIMES IN RING GAS LASERS. Gudkov, Yu.P.; Rozanov, N.N. Sov. J. Quantum Electron. 4: No. 12, 1439-1445 (June 1975).

A theoretical investigation is made of self-oscillatory regimes in ring gas lasers when stimulated emission occurs near the center of the gain profile. Allowance is made for the back scattering of the opposite waves in a ring laser. An analysis is made of a regime of weak periodic modulation of the amplitudes of the opposite waves and of the difference between their phases near the boundary of the frequency locking region. A new type of pulse beats, characterized by periodic sudden jumps of the difference between the wave phases, is discovered. A study is made of a locking-beats hysteresis, when—depending on the initial conditions—either steady-state locking or beats are obtained. (auth)

14210 INFRARED-PUMPED THIRD-HARMONIC AND SUM-FREQUENCY GENERATION IN DIATOMIC MOLECULES. She, C.Y. (Department of Physics, Colorado State University, Fort Collins, Colorado 80523); Billman, K.W. Appl. Phys. Lett. 27: No. 2, 76-79 (15 July 1975).

Using molecular hydrogen as a model system, we present the first calculation which demonstrates the feasibility of efficient third-harmonic and sum-frequency generation of ir laser radiation by diatomic molecular gases. A conversion efficiency of 10% without phase matching is achievable with a modest laser intensity of about 20 MW/cm^2. In addition to a two-photon resonance, the efficient conversion depends on a mechanism which makes use of virtual vibronic transitions exclusively. Possible methods for phase matching are also suggested. (auth)

14211 MAGNETICALLY TUNABLE LASER EMISSION FROM [Hg,Cd]Te. Weber, B.A.; Sattler, J.P.; Nemarich, J. (Harry Diamond Laboratories, Adelphi, Maryland 20783). Appl. Phys. Lett. 27: No. 2, 93-95 (15 July 1975).

Tunable spin-flip Raman and recombination laser emission from [Hg,Cd]Te have been observed using a chopped-cw CO_2 laser as the pump. Peak powers of over 1 mW and average powers of over 100 μW have been obtained for both the spin-flip Raman and recombination emissions with conversion efficiencies of over 0.3%. A zero-field g factor of $|g|=3$ has been measured, corresponding to a conduction band-edge effective-mass ratio of 0.0098 ± 0.0004. (auth)

14212 THREE-MIRROR STABLE RESONATOR FOR HIGH POWER AND SINGLE-MODE LASERS. Wang, C.P. (The Aerospace Corporation, P.O. Box 92957, Los Angeles, California 90009); Sandstrom, R.L. Appl. Opt. 14: No. 6, 1285-1289 (June 1975).

A stable, high Q, three-mirror resonator is proposed for the optimum output coupling and mode control of high power moderate-gain lasers. Theoretical calculations on the beam intensity distributions, spot sizes, and stability conditions are given. Alignment tolerance for a limiting case is discussed. Experimental results with a high power argon-ion plasma tube and a three-mirror stable resonator agree with the theory. (auth)

14213 ACOUSTICAL WAVE EFFECTS ON THE BEAM QUALITY OF A HIGH ENERGY CO ELECTRIC DISCHARGE LASER. McAllister, G.L.; Draggoo, V.G.; Eguchi, R.G. (Northrop Research Technology Center, High Power Laser Program, Hawthorne, California 90250). Appl. Opt. 14: No. 6, 1290-1296 (June 1975).

A high efficiency CO, e^--beam sustained electric discharge laser has been operated at 500 J/pulse with near diffraction limited beam quality. The high Fresnel number cavity configuration employs a confocal unstable resonator with a geometric magnification of ≈ 2.5. In spite of the high quantum efficiency of the CO laser, significant fractions of the pumping energy are absorbed in the gas as bulk heating giving rise to acoustic waves that refract portions of the light from the beam axis. The strength of the density waves have been measured using interferometric techniques and correlate well with the observed refraction of the laser light. (auth)

14214 IODINE STABILIZED LASER WITH THREE INTERNAL MIRRORS. Cole, J.B.; Bruce, C.F. (National Measurement Laboratory, CSIRO, University Grounds, Chippendale, NSW, Australia 2008). Appl. Opt. 14: No. 6, 1303-1310 (June 1975).

The construction and operation of an He–^{20}Ne laser stabilized by saturated absorption in $^{129}I_2$ vapor are described. The laser is of fused silica construction with internal mirrors. The interaction of the iodine absorber with the oscillating mode is modified by the use of a three-mirror cavity with a control system employing simultaneously first- and third-harmonic error sensing. Measurements are presented of the frequency stability of the laser and its wavelength against the ^{86}Kr standard. If the Rowley-Hamon model of the krypton line profile is assumed and the defined wavenumber is assigned to the mean of the peak and the centroid, the measured wavelength of the m hyperfine component is 632991 327±0.7 fm. (auth)

14215 GRADED-GAIN DYE LASER AMPLIFIERS: AN EXPERIMENTAL INVESTIGATION. Burlamacchi, P. (Istituto di Ricerca sulle Onde Elettromagnetiche, Firenze); Pratesi, R.; Salimbeni, R. Appl. Opt. 14: No. 6, 1311-1315 (June 1975).

The influence of inhomogeneous distributions of gain and refractive index produced by the pumping radiation on the performance of dye laser amplifiers is discussed. Experimental measurements in capillary cylindrical cells and planar cells are reported for single-pass, double-pass, and ring configurations. Gain factors up to 8.5×10^4 have been obtained at low signal input with rhodamine 6G in ehtanol. A saturated gain of 5×10^3 at 100-mJ output with an over-all efficiency of 0.1% has been achieved without full optimization of the amplifier parameters. The reported results indicate that a two-stage double-pass amplifier driven by a dye laser oscillator in the milliwatt region can be used as an efficient high energy light source. (auth)

14216 MOLECULAR GAS ULTRAVIOLET LASERS. I. Electronic Pumping of Gas in the Noncondensed Phase. Girardeau–Montaut, J. P. (Clermont–Ferrand Univ., Puy-de-Dome, France). Onde Electr.; 54: 456-462(Nov 1974). (In French).

Although only a small number of diatomic molecular gases (N_2, O_2, H_2, and CO) have been experimented on with success, the principal spectral characteristics and pumping of this type of laser can be defined. The transitions, the power and the duration of laser emission vary strongly as a function of the efficiency and of the technology of the system of pumping. Several types of setups have been developed and their performances are compared. Taking account of these data, some of the future perspectives of this class of lasers are discussed, together with further research of new laser emissions in the near- and far-ultraviolet. (IAA)

14217 MOLECULAR GAS ULTRAVIOLET LASERS. II. Pumping of Rare Gases by Electron Beams. Lagarde, F.; Novaro, M. (Centre d'Etude de Limeil, Villeneuve-Saint Georges, France). Onde Electr.; 54: 463-466(Nov 1974). (In French).

Optical pumping does not permit descent below 2500 Å, and in order to go beyond that pumping by electronic excitation is used. Beams of fast electrons exciting denser mediums such as xenon under pressure, for a few nanoseconds are used to achieve a laser emission at 1726 Å. Details of the experimental setup are presented. (IAA)

14218 EXCIMERIC XENON LASER: FEASIBILITY AT QUASI-ATMOSPHERIC PRESSURE. Collier, F.; Michon, M. (Compagnie Generale d'Electricite, Marcoussis, France). Onde Electr.; 54: 467-473(Nov 1974). (In French).

After a review of excimer properties, their main formation processes are reported. Spectral and temporal characteristics of xenon spontaneous emission at 1700 Å, as a function of pressure temperature and different impurities concentrations, were obtained. Excimer population evolution as a function of these parameters are deduced. Feasibility of an excimer xenon laser at quasi-atmospheric pressure seems possible from the experimental results. (IAA)

14219 APPLICATION OF A PICOSECOND LASER TO THE PRODUCTION OF COHERENT X RAYS. Lacour, B.; Michon, M. (Compagnie Generale d'Electricite, Marcoussis, France). Onde Electr.; 54: 474-478(Nov 1974). (In French).

A picosecond laser is described and some features of the laser plasma interaction are studied. It is shown that, with the existing lasers, it is possible to ionize almost completely the atoms of the target. Recombinations could then populate more specially metastable states of highly ionized species and allow subsequent amplification in the plasma near 10 A. The glass laser intended to create the plasma, and the feasibility of an x-ray laser are discussed. (IAA)

14220 THRESHOLD EVALUATIONS FOR AN X-RAY LASER. Arecchi, F. T.; Banfi, G. P.; Malvezzi, A. M. (Univ., Pavia, Italy). Opt. Commun.; 10: No. 3, 214-218(Mar 1974).

Photoelectric pumping of inner shells of intermediate Z materials is shown to be efficient for inverting the population of radiative transitions around 1 keV. Non-radiative processes are shown to be essential for achieving a stationary inversion. Reported intense x-ray bursts from plasmas generated by laser radiation suggest the use of a Nd laser as exciting source. Threshold evaluations show that a mirrorless x-ray laser is possible by use of available Nd lasers. (auth)

14221 OUTPUT POWER OF GAS LASERS WITH MIXED CONTOUR OF THE SPECTRAL LINE OF THE WORKING TRANSITION. Lazarev, L. P.; Matveev, V. I.; Rozhkov, O. V. Tr. Mosk. Vyssh. Tekh. Uchil.; No. 184, 18-33(1974).

Approximate analytical expressions are derived for calculating the output power of He–Ne gas lasers with emission wavelength of $\lambda = 0.6328$ μm in the single-frequency and multifrequency emission modes. An examination is made of the mixed contour of the spectral line of the working transition. It is shown that the analytical expressions agree satisfactorily with experimental data. (Ref. Zh.)

14222 TIME STRUCTURE OF SEMICONDUCTOR INJECTION PULSE LASER EMISSION. Deryagin, V. N.; Marasin, L. E.; Popov, Yu. V.; Portnoy, E. L. Opt.-Mekh. Prom.; No. 8, 17-20 (1974). (In Russian).

The results of an investigation of the near-field time structure of emission of semiconductor lasers of various types are presented, and a mechanism of formation of this structure is suggested. It is shown that the space-time nonhomogeneity of near-field emission of heterolasers in the system $Al_xGa_{1-x}As$-GaAs-$Al_xGa_{1-x}As$ is approximately an order lower than in semiconductor lasers based on diffusion pn junctions and unilateral heterostructures. (Ref. Zh.)

14223 OUTPUT POWER AND EMISSION SPECTRUM OF A LASER WITH THREE-MIRROR CAVITY. Lazareva, N. L.; Matveev, V. I.; Nemtinov, V. B.; Drozdov, M. M. Tr. Mosk. Vyssh. Tekh. Uchil.; No. 184, 84-96(1974). (In Russian).

Based on the example of a three-mirror laser, a procedure for calculating the spectra of a laser with complex cavities is considered. The method enables calculating the frequencies of emission lines, line shift as a function of excess gain over losses, and also approximation of the line intensities at the output when emission is coupled out through any coupling element of the complex cavity. Numerical data are presented which were found on a computer for an actual laser circuit with three-mirror linear cavity. (Ref. Zh.)

14224 PROBLEMS OF DESIGNING GAS LASERS. Drozdov, M. M.; Matveev, V. I.; Rozhkov, O. V. Tr. Mosk. Vyssh. Tekh. Uchil.; No. 184, 140-148(1974). (In Russian).

An examination is made of some questions of designing gas lasers with emission on the TEM_{00} mode. A procedure is given for determining the inside diameter of a gas-discharge tube which corresponds to low diffraction losses for the TEM_{00} mode. The laser cavity length is found for which output power saturation occurs for He–Ne gas lasers with emission wavelength of $\lambda = 0.6328$ μm. (Ref. Zh.)

14225 INJECTION LASER-PUMPED DYE LASER TUNABLE IN THE INFRARED. Fraas, L. M. (Univ. Estadual, Campinas, Brazil). Rev. Bras. Fis.; 3: 425-430(Dec 1973).

Extrapolation of data for transverse ruby laser pumped 3.3-diethylthiotricarbocyanine bromide indicates that this dye will lase with diode injection laser pumping with a threshold of 25 to 30 KW/cm^2 and an efficiency near 20%. Such a diode-pumped dye laser could be quite useful as a broadband amplifier in a laser communication system. (Int. Aerosp. Abstr.)

14226 LAZERI. (Lasers). Visots'kii, V. Z. Kiev; Vidavnitstvo Naukova Dumka (1973). 168p. (In Ukrainian).

The present work sets forth the basic principles of quantum electronics and the operating principles of solid-state lasers, gas lasers, liquid-dye lasers, and semiconductor lasers. The approach is general with a minimum of quantitative information. The use of lasers in various industrial and research applications is described. (IAA)

14227 ESTABLISHMENT OF OSCILLATIONS IN A LASER CAVITY WITH LOW GAIN OF THE ACTIVE MEDIUM WHEN CONTINUOUS PUMPING OCCURS. Drozdov, M. M.; Rozhkov, O. V.; Tkach, N. A. Tr. Mosk. Vyssh. Tekh. Uchil.; No. 184, 45-54 (1974). (In Russian).

Analytical relations are found which describe the change of energy density in a laser cavity in time when there is a stepwise change in the excess gain over the threshold. Formulas are presented for calculating the time of the transient process in a laser with homogeneous and nonhomogeneous broadening of the line of

the working transition of the active medium. The method is based on equivalent representation of the laser by an electrical oscillatory circuit. Results of experimental studies of transient processes in a laser cavity are given. (Ref. Zh.)

14228 INDUSTRIAL LASERS AND THEIR APPLICATIONS. Harry, J. E. New York; McGraw-Hill Book Company (1974). 199p.

An introduction to optical radiation processes is provided, taking into account emission processes, fluorescence, stimulated emission, and questions of laser operation. Laser characteristics are discussed along with materials and components used in laser systems and aspects related to safety considerations. Industrial lasers considered include solid-state lasers, gas lasers, dye lasers, and semiconductor lasers. Questions of industrial laser applications are explored, giving attention to the use of lasers in metrology, the manufacture of electronic components, medical applications, inspection techniques, pollution detection, analytical techniques, holography, communications, and information processing. (IAA)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 14092, 14402, 15759, 15765, 15766, and 15768.

14229 SOLUTION TO THE TRAINING PROBLEM IN SUPERCONDUCTING MAGNETS. Smith, P. F.; Colyer, B. (Science Research Council, Chilton, Eng.). Cryogenics; 15: No. 4, 201-207(Apr 1975).

A major factor in the design of large superconducting magnets is the problem of premature quenching, notably the "training" effect, associated with the use of epoxy resin impregnants. The existence of a simple but neglected solution to this problem is discussed. A review is given of a series of tests carried out in 1968 to 71 which showed that such effects were considerably reduced in the case of solenoid and quadrupole coils impregnated with wax or oil, allowing currents at least 85 to 90% of the critical value to be achieved consistently and reliably. The tests included a full scale prototype quadrupole (9 cm bore, 40 kG maximum field). A discussion of the mechanical and thermal properties of such coils indicates no reason to doubt their long term reliability, and the adoption of this solution for operational magnets is recommended. (auth)

14230 PROBLEMS OF CREATING TURBOGENERATORS WITH SUPERCONDUCTOR AND PURE METAL WINDINGS. Schastlivii, G. G.; Fredorenko, G. M.; Kuevda, V. P.; Kuchinskii, V. P. (Inst. of Electrodynamics, Kiev). Probl. Tekh. Elektrodin.; No. 38, 4-9(1972). (In Russian).

A study was made of the characteristic peculiarities and problems associated with using superconductors and pure metals in high-power turbogenerators. Examples demonstrate the possible design modifications for making rotors with superconductive field winding, their common features and differences. Based on an analytical survey of the materials available in the scientific and technical literature, it is noted that the most important research for developing workable and effective designs for cryogenic turbogenerators concerns heat insulation and the thermal stability of the superconductive field winding, dissipation fields and the electrodynamic forces in the steady-state and transient modes of operation. (JPRS)

14231 FEMTOJOULE JOSEPHSON TUNNELING LOGIC GATES. Herrell, D. J. (IBM T.J. Watson Research Center, Yorktown Heights, NY). IEEE (Inst. Electr. Electron. Eng.) J. Solid-State Circuits.; sc-9: No. 5, 277-282(Oct 1974).

The design of Josephson tunneling logic (JTL) gates capable of performing the logic functions of AND, OR, INVERT and CARRY is considered. The design equations were solved for a rectangular Josephson junction in which the geometry was adjusted to ensure that all logical inputs were equivalent. Experimental JTL gates were found to operate with a logic delay of less than 200 ps, and with a power-delay product of the order of five femtojoules. (Elec. Electron. Abstr.)

14232 CURRENT-VOLTAGE CHARACTERISTICS OF A NEW TYPE OF SUPERCONDUCTING THIN FILM BRIDGE. Smith, C. W.; Bohner, J. J. (Maine Univ., Orono (USA)). Phys. Lett., A; 51: No. 8, 453-454(5 May 1975).

Well defined critical current and current hysteresis are observed for a new type of superconducting bridge fabricated using a shadowing technique to vary the film thickness. (auth)

14233 APPLICATION OF SUPERCONDUCTIVITY IN ELECTROTECHNICS. Penczynski, P. (Siemens A. G., Erlangen (F. R. Germany). Zentrale Forschung und Entwicklung). Tech. Mitt.; 67: No. 12, 562-571(Dec 1974). (In German).

From meeting on low temperature technology and its materials; Essen, F. R. Germany (25 Jun 1974).

The properties of technically interesting superconductors and the application of these conductors in high-power magnets, machines and cables are described. (GE)

14234 LIFT, DRAG, AND GUIDANCE FORCES ON ALTERNATING POLARITY MAGNETS, USING LOOP GUIDEWAYS. Lindenbaum, S.D.; Lee, M.S. (Grumman Aerospace Corporation, Bethpage, New York 11744). J. Appl. Phys. 46: No. 7, 3151-3159 (July 1975).

Exact solutions of track current, lift force, and drag force, together with their velocity dependence, have been computed for a vehicle carrying a finite number of fixed current alternating polarity superconducting magnets, suspended at various heights over structured track guideways of the single- and double-loop ("null") types. Results for the double-loop case are compared with those of a previously reported approximate analysis. The analytical method is then applied to a study of a low-drag guidance loop guideway which is integrable with lift loop guideways utilizing a common set of vehicle magnets. Solutions are obtained for guidance track restoring forces, lateral destabilization forces, and lift force degradation as functions of lateral displacement from symmetry. The dependence of lift, drag, and lift-to-drag on track loop parameters is studied and the linear dependence of lift-to-drag on loop time constant confirmed. The contribution to the forces made by successive addition of alternating polarity magnets is calculated and the marked reduction in lift force pulsation noted. (auth)

14235 NEW CONFIGURATION FOR A SUPERCONDUCTING WEAK LINK. Lum, W.Y.; Van Duzer, T. (Department of Electrical Engineering and Computer Sciences, and the Electronics Research Laboratory, University of California, Berkeley, California 94720). J. Appl. Phys. 46: No. 7, 3216-3218 (July 1975).

We report here a new method of making a Josephson device which, in some respects, is the fabricated equivalent of a point contact. The configuration has the potentiality for good heat-removal properties and has been shown to be temperature cyclable. The I-V characteristics, I_c-T dependence, and I_c-B relation for a parallel pair are given. (auth)

14236 TWO MODELS FOR JOSEPHSON OSCILLATORS. Hepp, K. (Physics Department, E.T.H., CH-8049 Zürich, Switzerland). Ann. Phys. (N.Y.) 90: No. 2, 285-294 (Apr 1975).

Two exactly soluble quantum mechanical models for tunneling oscillators are discussed. The first one is a closed weak coupling system, in which the current is nondissipative. In the second, open strong coupling system the oscillation occurs as a reservoir driven phase transition of the first kind far from thermal equilibrium. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 16499, 16507, 16569, 16608, and 16631.

14237 (ANCR-1193) GOVERNING EQUATIONS FOR A SERIATED CONTINUUM: AN UNEQUAL VELOCITY MODEL FOR TWO-PHASE FLOW. Solbrig, C. W.; Hughes, E. D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). May 1975. Contract AT(19-1)-1375. 57p. Dep. NTIS $5.45.

The description of the flow of two-phase fluids is important in many engineering devices. Unexpected transient conditions which occur in these devices cannot, in general, be treated with single-component momentum equations. Instead, the use of momentum equations for each phase is necessary in order to describe the varied transient situations which can occur. These transient conditions can include phases moving in the opposite directions, such as steam moving upward and liquid moving downward, as well as phases moving in the same direction. The derivation of continuity and momentum equations for each phase and an overall energy equation for the mixture are presented. Terms describing interphase forces are described. A seriated (series of) continuum is distinguished from an interpenetrating medium by the representation of interphase friction with velocity differences in the former and velocity gradients in the latter. The seriated continuum also considers imbedded stationary solid surfaces such as occur in nuclear reactor cores. These stationary surfaces are taken into account with source terms. Sufficient constitutive equations are presented to form a complete set of equations. Methods are presented to show that all these coefficients are determinable from microscopic models and well known experimental results. Comparison of the present deviation with previous work is also given. The equations derived here may also be employed in certain multiphase, multicomponent flow applications. (auth)

14238 (CEA-N-1786) STRUCTURE ANALYSIS SYSTEM. Presentation Note on the Thermal Three-Dimensional Module. Charras, T.; Guerin, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Mar 1975. 15p. (In French). INIS.

A new possibility of the system of programs CEA-SEMT is described: thermal calculation of three-dimensional structures in static and dynamic field. (FR)

14239 (FEI-446) FRICTION FACTOR ANISOTROPY IN POROUS BODIES CONSISTING OF ROD BUNDLES. Gorchakov, M. K.; Kolmakov, A. P.; Yur'ev, Yu. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 18p. (In Russian). INIS.

Using USSR and foreign experimental data, coefficients of friction were compared in longitudinal and transverse flow around staggered rod bundles, the coefficient of anisotropy of friction in porous bodies consisting of rod bundles was determined, and different methods of recording and simplifying hydrodynamic equations for porous bodies were examined. (tr-auth)

14240 (KFK-1981) MEASUREMENTS OF VELOCITY-FIELDS AND TEMPERATURE-FIELDS IN LAMINAR AND TURBULENT FREE CONVECTION BOUNDARY LAYERS. Fieg, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Feb 1975. 32p. (In German). Dep. NTIS (US Sales Only) $4.75.

The hydrodynamics of laminar and turbulent free convection boundary layers on a vertical flat isothermal plate was studied. Both for the laminar and turbulent region there is a good agreement with previous experimental and theoretical investigations. From these experiments important conclusions can be drawn about the growth of instabilities in the transition region which lead to turbulence. (auth)

14241 WAVE PROPAGATION AND CHOKING IN TWO-PHASE TWO-COMPONENT FLOW. Liles, D. R. Atlanta; Georgia Inst. of Tech. (1974). 122p. University Microfilms Order No. 75-13,000.

Thesis (Ph. D.).

The problem of wave propagation and choking has been examined analytically for gas-liquid flows. A drift-flux (mixture) model is employed and the solution is provided by the method of characteristics. The main thrust of the research is to produce a model which can predict the critical flux in two-component gas-liquid flows in conduits. The characteristics of the set of equations are examined and compared with speed of sound data and conclusions are drawn between the conditions at the critical point and the speed of pressure pulses in the system. While the main emphasis of the research is on two-component flows some one-component work is presented. (Diss. Abstr. Int., B)

14242 INSTABILITY OF TWO-PHASE FLOW IN VERTICAL CYLINDERS. Esmail, M. N.; Hummel, R. L.; Smith, J. W. (Univ. of Toronto). Phys. Fluids; 18: No. 5, 508-516(May 1975).

The stability of two-phase flow in a vertical cylinder is considered. The liquid phase is assumed to flow past the cylinder surface in a thin layer, assuming no mixing with the core gas flow. The complete system of Navier–Stokes and continuity equations for both phases is treated analytically, using a perturbation procedure based on expansion in powers of small wave numbers. The results of the first approximation determine the phase velocity of waves developed on the liquid-gas interface. The second approximation reveals the complete pattern of hydrodynamical stability of two-phase flow over the entire range of gas-flow velocities. The topological features of stability curves are depicted. The effects of surface tension, cylinder radius, and interface curvature on the two-phase flow stability are revealed. (auth)

Materials Testing

14243 (AED-CONF-74-462-003) SOME MEASURING TECHNIQUES FOR PROCESS CONTROL AND OPERATIONAL MONITORING. Ziegler, K. (Brown, Boveri und Cie A. G., Mannheim (F. R. Germany)). 1974. 11p. (In German). INIS.

From INTERKAMA 74; Duesseldorf, F. R. Germany (10 Oct 1974).

Available from ZAED.

The paper gives a survey of the various acoustic techniques employed for the (a) detection of incipient mechanical faults on machine and structural parts under load, (b) optimization of process control by the measurement and evaluation of the generated sound field, e.g., some measurements of reactor pressure vessels and noise analysis for monitoring turbine blades. (auth)

14244 MONITORING STRUCTURAL INTEGRITY BY ACOUSTIC EMISSION. Proceedings of a Symposium Held at Ft. Lauderdale, Florida, 17–18 January 1974. Spanner, J. C.; McElroy, J. W. (eds.). ASTM Special Technical Publication 571. Philadelphia; American Society for Testing and Materials (1975). 292p. (ASTM-STP-571; CONF-740117-). $23.75.

A separate abstract was prepared for three of the twelve papers presented at the conference. The remaining papers were not in scope for NSA. (TFD)

For abstracts of individual papers see: 14245–14247.

14245 INDUSTRIAL APPLICATION OF ACOUSTIC EMISSION ANALYSIS TECHNOLOGY. Parry, D. L. (Exxon Nuclear Co., Inc., Richland, WA). pp 150-183 of Monitoring Structural Integrity by Acoustic Emission. Spanner, J. C. (ed.). Philadelphia; American Society for Testing and Materials (1975).

From symposium on monitoring structural integrity by acoustic emission; Ft. Lauderdale, Florida, USA (17 Jan 1974). See ASTM-STP-571; CONF-740117-.

Acoustic emission analysis technology as a nondestructive testing tool is being applied in industry to a wide variety of structures. Its acceptance, however, has been more rapid in industries where it is applied to metallic pressure containment structures. These applications include pipelines, piping systems, storage vessels, pressure vessels, and even complex pressure containments such as the primary coolant systems of large nuclear power plants. The application techniques used and a description of typical results obtained during field applications provides additional insight into a new powerful testing tool that is rapidly gaining acceptance throughout the industry. (auth)

14246 ACOUSTIC MONITORING SYSTEMS TO ASSURE INTEGRITY OF NUCLEAR PLANTS. Gopal, R. (Westinghouse Nuclear Energy Systems, Pittsburgh). pp 200-220 of Monitoring Structural Integrity by Acoustic Emission. Spanner, J. C. (ed.). Philadelphia; American Society for Testing and Materials (1975).

From symposium on monitoring structural integrity by acoustic emission; Ft. Lauderdale, Florida, USA (17 Jan 1974). See ASTM-STP-571; CONF-740117-.

A comprehensive program is underway at the Westinghouse Electric Corporation to develop and evaluate acoustic monitoring systems as a nondestructive testing tool for nuclear power plants that will assure structural integrity with minimum interference to normal power plant activities. A prime requirement for instrumentation for nuclear reactors is that it should function reliably in severe environments for several years. Sensors and instrumentation for source location and display developed for this application are described. Results of tests performed in major test facilities for vessel flaw growth, vessel rupture, and pipe rupture under various operating conditions are summarized. Evaluation performed in nuclear power plants both during hydro tests and operation of plant is presented. Laboratory tests for studying relationships between acoustic emission and fracture mechanics technologies are presented along with a summary of wave propagation results. Measurements, to date, indicate that an acoustic monitoring system has practical applications in nuclear power plants for improving safety and availability of plants. (auth)

14247 ACOUSTIC EMISSION: A BIBLIOGRAPHY FOR 1970–1972. Drouillard, T. F. (Dow Chemical Co., Golden, CO). pp 241-271 of Monitoring Structural Integrity by Acoustic Emission. Spanner, J. C. (ed.). Philadelphia; American Society for Testing and Materials (1975).

From symposium on monitoring structural integrity by acoustic emission; Ft. Lauderdale, Florida, USA (17 Jan 1974). See ASTM-STP-571; CONF-740117-.

The bibliography includes nearly all references in the literature on acoustic emission published during the three-year period, 1970 through 1972. Included in the 412 references are several for each of the associated technologies including: signature analysis, boiling detection, cavitation, leak detection, seismology, and rock mechanics. Information has also been obtained from eight abstracting and indexing services searched in compiling the bibliography. The bibliography has been arranged alphabetically by author and is cross referenced with a list of approximately 400 authors. Also included is a subject index. Technical articles listed were published in some 90 different journals and in 8 different languages. (auth)

14248 ULTRASONIC INSPECTION OF TUBES WITHOUT ROTATION. Perdijon, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service de Fabrication Industrielle des Elements Combustibles et Materiaux de Structure). Rev. Metall. (Paris).; 72: No. 1, 73-81(Jan 1975). (In French).

A device in which a conical mirror for the detection of transverse defects combined with a helicoidal mirror for longitudinal defects is described. The tests show that the detection of both internal and external defects is independent of the tube motion having the defect. (FR)

14249 CAN CRACKS BE FOUND BY RADIOGRAPHY. Halmshaw, R.; Hunt, C. A. (Royal Armoment Research and Development Establishment, Fort Halstead, Eng.). Br. J. Non-Destr. Test.; 17: No. 3, 71-75(May 1975).

From non-destructive testing conference; Lancester, Eng. (Sep 1974).

The limitations and the capabilities of radiography for detecting cracks are described. It is shown that the two parameters of a crack which are most significant in radiography are the crack opening (the separation distance between the faces) and the angle of the crack to the radiation beam. The dimensions of just-detectable natural cracks are determined from a theory of radiographic crack sensitivity and the effect of radiographic technique variations is described. The calculated values are shown to agree well with experimental results obtained by several investigators on both artificial and natural cracks. A comparison is made with the crack parameters which are important in ultrasonic crack detection, where the crack opening is of relatively little significance. (auth)

Nuclear Explosions

Refer also to abstract 14252.

14250 (ERDA-tr-45) RISKS OF NUCLEAR EXPLOSIVES PRODUCTION IN SECRET. Gylden, N.; Holm, L. W. Mar 1974. Translation by Maria Wood of FOA-4-DC4567-T3. 26p. Dep. NTIS $4.50.

The basic facts for judging the possibilities for countries, organizations, or individuals to produce a nuclear explosive in secrecy are examined. (TFD)

Protective Structures and Equipment

Refer also to abstracts 15040 and 16597.

14251 (LA-5958-MS) SPECIFICATIONS AND TEST PROCEDURES FOR AIRLINE-TYPE SUPPLIED-AIR SUITS. Revoir, W. H.; Pritchard, J. A.; Davis, T. O.; Richards, C. P.; Wheat, L. D. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-ENG-36. 15p. Dep. NTIS $4.00.

Procedures and requirements have been established to permit airline-type supplied-air suits needed by contractors of the Energy Research and Development Administration to be tested for performance by the Respirator Research and Development Section, Industrial Hygiene Group, of the Los Alamos Scientific Laboratory, and to have the adequacy of the performance of these devices evaluated by the Los Alamos Scientific Laboratory Respirator Advisory Committee. Test equipment, test methods, and performance criteria for airline-type supplied-air suits are prescribed. (auth)

14252 STRUCTURE SHIELDING AGAINST INITIAL RADIATIONS FROM NUCLEAR EXPLOSIONS. I. Attenuation of Air Secondary and Fission Product Gamma Rays. Spencer, L. V. (National Bureau of Standards, Washington, DC). Nucl. Sci. Eng.; 57: No. 2, 129-154(Jun 1975).

Calculations and resulting data are described which are intended for use in estimating the protection afforded by buildings against nuclear radiations emitted from a nuclear burst in the first half minute or so. The basic source configuration is that for which one assumes equal likelihood of the explosion occurring on a ring of elevation 30 deg above the horizontal, relative to a structure location on the ring axis. Source spectra and angular distributions corresponding to large distance (less than or approximately 1 mile) from burst point to structure are used. As sources, only gamma rays from fission products and from neutron interactions with air molecules are discussed. (auth)

14253 A PROTECTIVE SHIELD AGAINST MEDICAL IRRADIATIONS. Flaugnatti, R. B. French Patent 2,212,613/A/. 28 Dec 1972. 10p. (In French).

The shield or screen comprises a tight flexible envelope, containing at least a thermo-setting resin and a filler formed of fine particles of at least one substance adapted to absorb the medical radiation and evenly distributed throughout said resin, said envelope being provided between the parallel two walls thereof with a passage which is previous to the medical radiation. That protective shield is easy to use and can be fixed in position without dirtying the patient or the operator. (FR)

14254 ON THE OPERATION OF THE VENTILATION INSTALLATION IN THE HOT CELLS, BUILDING 701. Gaber, K. D.; Staud, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Reaktorbetrieb und Technik). pp 153-183 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (Apr 1974). (In German).

The draft of the ventilation system including the vacuum stage in the building has now proved itself after six years' operation. Even with fast changes of the reference pressure, the system exhibits a very good control characteristic. The high operational safety has enabled the continuous use of hot cells and has protected the personnel and working rooms from contamination. (auth)

14255 BYPASS SYSTEMS WITH DOUBLE COVERS IN THE "HOT CELLS". Schneider, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Reaktorbetrieb und Technik). pp 185-205 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (Apr 1974). (In German).

The utilization of the double cover systems has considerable advantages compared to the plastic sack methods. An attempt is thus being made to equip old plants with double cover systems where possible. New plants should possess in their draft all possibilities of installing double systems, for manipulators and material to be examined as well as for working devices, apparatus and equipment. (auth)

14256 TESTING OF FILTERS. Fraser, D. C. (to United Kingdom Atomic Energy Authority). British Patent 1,387,408/B/. 19 Mar 1975. Filed Date 3 Nov 1971. 3p.

The method described involves the generation of condensation nuclei by the combustion of a suitable substance, entraining the nuclei in a suitable gas, passing the gas through the filter under test, and measuring the concentration of nuclei in the gas on both the upstream and downstream sides of the filter, thereby determining the efficiency of the filter. The combustible substance may comprise a solution of $(NH_4)_2S$ in methylated spirit. The apparatus required is described in detail. A Pollak counter is used for measuring the concentration of condensation nuclei. The apparatus is claimed to avoid pyrotechnic hazards. The entraining gas may be air. (UK)

Safety Engineering

14257 (NVO-410-21(Rev.1)) CROSS-INDEX TO ERDA-PRESCRIBED INDUSTRIAL SAFETY CODES AND STANDARDS. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev. (USA)). Jan 1975. Contract AT(26-1)-410. 677p. Dep. NTIS $37.00.

This is the first revision of the original cross index (NVO-410-21) published in 1974. Pertinent items from approximately 300 industrial safety codes and standards prescribed by USERDA are contained in this Cross-Index. A library of these codes is maintained in the REECo Industrial Safety and Fire Protection Office. The Cross-Index was developed to simplify reference to specific items in the rapidly growing list of industrial safety codes and standards. As the name implies, it is primarily concerned with industrial operations, including construction; industrial hygiene, radiation, and fire protection items are included only as they appear in the prescribed industrial codes and standards. (RCK)

14258 (UCRL-50007-74-2) HAZARDS CONTROL PROGRESS REPORT NO. 49, JULY-DECEMBER 1974. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Feb 1975. Contract W-7405-Eng-48. 60p. Dep. NTIS $5.45.

Progress and technical notes on the following topics are given: light particle track registration for personnel neutron dosimetry; semi-annual TLD packet exchange frequency; respirator cartridge service life measurements; carbon tetrachloride cartridge testing system; miscellaneous gas cartridge testing system; a system to produce low concentrations of gas and solvent vapor in air; respirator cartridge and canister humidification systems; neutron spectrometer development; microcomputer logs effluent characteristics; a hydraulic drum crusher; HEPA-filter smoke plugging studies; LLL participation in the 1974 ORNL nuclear accident dosimetry intercomparison; passive neutron monitoring with TLD chips in a 10-in.-diameter polyethylene sphere; computation of the radiation dose from inhaled radioactive aerosols; airborne activity resulting from cleaning liquid spills with a wet vacuum cleaner; preliminary results of cosmic ray neutron measurements at 12.5 km; whole-body counting results following accidental inhalation and ingestion of ^{109}Cd; calculated photopeak efficiency of a small Ge(Li) detector; hydrogen-chloride-to-chlorine catalytic converter; modifications to the NBS/LLL smoke density chamber; friction loss studies-0.0127 m fire hose; activation foil neutron spectra in the core of the LPTR; and composite asbestos fibers. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 13836, 13892, and 14640.

14259 (AED-CONF-74-600-004) THE RAW MATERIALS POLICY OF THE FEDERAL GOVERNMENT CONCERNING NATURAL URANIUM. Hauerstein, G. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). 1974. 11p. (In German). INIS.

From symposium on natural uranium supply; Mainz, F. R. Germany (18 Nov 1974).

With abstract.

Taking the example of the up to present four atomic programs, the efforts made by the Federal Government to secure a natural uranium supply are explained. Data on uranium demand and cost as well as the extended use of government allowances are given. Furthermore the additional political measures are explained. (GE)

14260 (GJO-100(75)) STATISTICAL DATA OF THE URANIUM INDUSTRY. (Energy Research and Development Administration, Grand Junction, Colo. (USA). Grand Junction Office). 1 Jan 1975. 86p. Dep. NTIS $7.50.

Statistical data are given on the following: ore and concentrate purchases; uranium resources--ore reserves, ore production, and potential resources; distribution of $8, $10, and $15 reserves; drilling statistics; uranium exploration expenditures; land holdings for uranium mining and exploration; employment; commercial U_3O_8 sales and requirements; and processing mills. (LK)

14261 (NP-20456, pp vp Paper 3) ENVIRONMENTAL EFFLUENTS FROM URANIUM-FUELED LIGHT WATER REACTOR. Pigford, T. H. (Univ. of California, Berkeley); Keaton, M. J.; Mann, B. J. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The following topics are discussed: reactor characteristics; uranium mining; milling and concentration; conversion of U_3O_8 to UF_6; uranium enrichment; fuel conversion and fabrication; nuclear power plant operation; radioactive noble gases; gaseous radioiodine; tritium in gaseous effluents; radioactive particulates in gaseous effluents; tritium in liquid effluents; shipment of irradiated fuel and solid radioactive wastes; fuel reprocessing; management of high-level radioactive wastes; accidental environmental releases; and effect of plutonium utilization. (HLW)

14262 (NP-20456, pp vp Paper 5) ENVIRONMENTAL EFFLUENTS FROM URANIUM-PLUTONIUM FUELED BREEDER REACTOR. Pigford, T. H. (Univ. of California, Berkeley); Keaton, M. J.; Mann, B. J. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The following topics are discussed: reactor characteristics and fuel requirements; cooling irradiated fuel; radiological releases from reactor; mining, milling, and fuel fabrication; shipment of irradiated fuel; fuel reprocessing; management of high level radioactive wastes; and accidental environmental releases. (HLW)

14263 SOIL RADIUM METHOD FOR URANIUM PROSPECTING. Sutton, W. R.; Soonawala, N. M. (McGill Univ., Montreal). Can. Mining Met. Bull.; 68: No. 757, 51-56(May 1975).

The soil radium technique of uranium exploration is described. Radium in soil samples is measured by immersing them in water for a fixed period, and then analyzing for the radon emanated into the water. The method achieves an increase of at least several feet in depth penetration over that possible by radiometric equipment. Field examples are provided, which compare soil radium, scintillometer, and emanometer results over specific uranium occurrences near Uranium City, Saskatchewan. Some of the other advantages of the soil radium method are that results can be obtained at the site of the survey, equipment is simple and results are reproducible. (auth)

14264 NEW SOURCES OF URANIUM: TYPES OF URANIUM DEPOSITS PRESENTLY UNKNOWN IN CANADA. Ruzicka, V. (Geological Survey of Canada, Ottawa). Can. Min. J.; 96: No. 4, 41-44(Apr 1975).

Fourteen basic types of uranium deposits are described. Ten types are presently unknown in Canada. Examples of these ten types are given and the chances of their occurrence in Canada are briefly analyzed. (CA)

14265 URANIUM TO 2000: AN EXPLORATION CHALLENGE. Williams, R. M. (Dept. of Energy, Mines, and Resources, Ottawa). Can. Min. J.; 96: No. 4, 29-32(Apr 1975).

World-wide uranium consumption is forecast to be in the range of 400 to 490 thousand tons of U_3O_8 by the year 2000. The world's currently delineated low-cost reserves are sufficient to meet demand for the next 14 years. Over the next 15 year period, new reserves totalling some 2.6 million tons of U_3O_8 must be developed. By 1990, annual gross additions to reserves must be around 270,000 tons of U_3O_8. If these additions come from new discoveries alone, annual world exploration expenditures would be between $500 and $600 million by 1990. The implications of these forecasts for exploration strategy, exploitation of lower grade deposits, and financing alternatives are discussed. (CA)

14266 URANIUM-XENON DATING BY THERMAL NEUTRON IRRADIATION. Gopalan, K.; Rao, M. N. Can. J. Earth Sci.; 12: No. 5, 887-890(May 1975).

A new approach to the dating of uranium minerals using the spontaneous fission of uranium is proposed. The method involves thermal neutron irradiation of samples followed by mass spectrometric analysis of the xenon fractions released from them during stepwise heating. The potential advantages of the technique are the following: no separate explicit measurement of uranium is required, the error in age measurement due to inhomogeneous uranium distribution in samples is eliminated, and any diffusive loss of spontaneous fission xenon from less retentive sites is allowed for. (auth)

14267 FEDERAL-PROVINCIAL URANIUM RECONNAISSANCE PROGRAM. Darnley, A. G.; Cameron, E. M.; Richardson, K. A. Can. Min. J.; 96: No. 4, 71(Apr 1975).

A Federal-Provincial Uranium Reconnaissance Program is being initiated in Canada to provide governments and industry with nationally consistent systematic data upon which uranium resource appraisals can be made. Airborne gamma spectrometry grids will be assembled for areas combining flat topography and thin overburden. Regional geochemistry will be used in mountainous areas or where there is thick overburden or favorable occurrences are suspected. Hydrogeochemistry will be used wherever possible but especially for subsurface waters. (CA)

14268 GEOCHEMISTRY APPLIED TO URANIUM EXPLORATION. Dyck, W. (Geological Survey of Canada, Ottawa). Can. Min. J.; 96: No. 4, 58-62(Apr 1975).

The principles of hydrogeochemical exploration for uranium deposits are reviewed. The mobility of ^{238}U and its decay products in various environments is discussed. Analyses center on U, Ra, and Rn. Helium is too difficult to measure and interpret, except in deep ground waters. Interpretation of results must take into account background, flow rates, geophysical relief, water chemistry, the presence of associated heavy metals, and climate. (CA)

14269 URANIUM PROVINCE PREPARES FOR DEVELOPMENT. Ecos; No. 1, 22-26(Aug 1974).

The Alligator Rivers region environmental fact finding study is reviewed. The report considers the effects of uranium mining on the ecology and concludes the drainage system has only a very small capacity to absorb without damage increased quantities of elements such as zinc, copper, and manganese, that may occur in uncontrolled run-off from mining operations. Controls would also be needed to be exercised on total amounts of radioactive elements released from uranium mining and processing operations and on concentrations at discharge. Aims of the environmental study are given as well as resources of uranium in the area. (AT)

14270 FRENCH URANIUM RESOURCES. Maget, R. (CEA Direction des Productions, 92 – Chatillon (France)). Rev. Ing. Ec. Natl. Super. Mines.; 27: No. 233, 19-23(May 1974). (In French).

The French uranium industry position, the needs to be met, and the chosen supply policy are briefly reviewed. The role of the resources and mines situated on French territory and their contribution to the security of the country are examined more particularly. (FR)

14271 MARKET FOR URANIUM AND PLUTONIUM. Mommsen, J. (Nuclear Exchange Corp., Menlo Park, CA). Proc. Am. Power Conf.; 36: 241-246(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

14272 AN EVALUATION OF THE URANIUM-THORIUM-HELIUM METHOD FOR DATING YOUNG BASALTS. Leventhal, J.S. (Laboratory of Isotope Geochemistry, Department of Geosciences,

University of Arizona, Tucson, Arizona 85721). J. Geophys. Res. 80: No. 14, 1911-1914 (10 May 1975).

Comparison of K-Ar and ages based on U-Th-He on young basalts from the San Francisco Volcanic Field near Flagstaff, Arizona, shows that approximately one fifth of the He is retained and thus U-Th-He ages are too young. Leaching with weak acid produces larges losses of U in only a few minutes, which suggests that He is lost from surficial positions on minerals from radiation damage sites and from interconnecting crystal defects. One sample of large plagioclase phenocrysts showed excess He. It seems unlikely that the U-Th-He method can be used to obtain reliable ages on young basalts. (auth)

Radioactive Effluents

Refer also to abstracts 13909, 13910, 14261, 14262, 14306, 14504, 16541, 16542, 16571, and 16572.

14273 (BNWL-1950(Pt.3), pp 22-24) RADIONUCLIDES FROM NUCLEAR POWER REACTORS. Thomas, C. W. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research, Part III, Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Because of the anticipated use of nuclear power reactors as a power source, the relative concentrations of transuranium radionuclides expected to be present in radioactive wastes from these reactors were calculated. This will aid in predicting the environmental hazards posed by accidental release of radioactive wastes. (auth)

14274 (NP-20456) ENVIRONMENTAL ANALYSIS AND ENVIRONMENTAL MONITORING FOR NUCLEAR POWER GENERATION. (California Univ., Berkeley (USA)). 1974. vp.

Separate abstracts were prepared for 24 papers. (HLW)

For abstracts of individual papers see: 13884, 14261, 14262, 14275, 14284–14287, 14299, 14302, 14312, 14332, 14333, 14337, 14503, 14504, 15029, 15043, 16052, 16244, 16557–16559, and 16660.

14275 (NP-20456, pp vp Paper 13) IMPACT OF RADIOLOGICAL EFFLUENTS IN SURFACE WATERS. Seymour, A. H. (Univ. of Washington, Seattle). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Various aspects of the impact of radioactive effluents in surface waters are outlined. The following topics are included under the heading, transfer of radionuclides from water to man: radionuclide input; fate of radionuclides in water; biological uptake of radionuclides; loss of radioactivity by aquatic organisms; and pathways. The following topics are included under the heading, biological impact of radionuclides in aquatic environments: radiation stress; standards for radionuclides in water; AEC appendix 1 to 10 CFR, Part 50; radiation measurement; effects on man; and risk estimates. (HLW)

14276 (TID-26833) RADIOACTIVE WASTE IN THE MARINE ENVIRONMENT. Lowman, F. G. (Puerto Rico Nuclear Center, Mayaguez). 1975. 17p. Dep. NTIS $4.00.

The introduction of radionuclides into near-shore marine areas is considered in relation to Federal Regulations and to the hazards posed to man and to marine organisms living near the site of introduction of the contaminants. The use of the critical pathway concept, for evaluating hazards to man from radionuclides in his food, is discussed and the specific activity concept is applied to demonstrate the degree of hazard to man which could result from normal reactor operation using sea water for the coolant. The relative hazards to marine organisms from naturally occurring and reactor-produced radionuclides are also evaluated. (auth)

14277 NUCLEAR POWER: THE PERSPECTIVE OF RISK. Lister, B. A. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Atom (London); No. 223, 68-75(May 1975).

Assessments of the risks and benefits of nuclear power are discussed under the following headings—public concern; protection standards; sources of population exposure; highly active wastes; accident probabilities and consequences; the fast breeder reactor; plutonium; and security. Attempts are made to set opposing views in perspective. (UK)

Radioactivity Monitoring and Transport

Refer also to abstracts 14274, 14277, 14338, 14504, 15033, and 16593.

14278 (BNWL-1884) AQUATIC STUDIES OF GABLE MOUNTAIN POND. Cushing, C. E.; Watson, D. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-2130. 33p. Dep. NTIS $4.00.

Studies of the biotic and abiotic components of the Gable Mountain Pond (HAPO cooling water disposal pond) ecosystem were undertaken to determine if there was a potential problem for off-site transfer of radioactivity to man originating with the aquatic food web. Most of the ^{137}Cs in the pond is associated with the sediments which are probably the main source of ^{137}Cs for uptake by the biota. Generally, highest concentrations of ^{137}Cs and other radioisotopes were found in the upper two inches of sediments in the northwest end of the pond and in the deeper areas along the long-axis of the pond. Native goldfish had maximum and average ^{137}Cs concentrations of about 340 and 170 pCi/g dry wt, respectively. Algae, macrophytes, and detritus comprised the main food items of the goldfish, and the ^{137}Cs levels in the plants were usually higher than the ^{137}Cs concentration in the fish. The ^{137}Cs concentrations of wild experimental ducks restricted to Gable Mountain Pond were approximately the same as resident coots, but significantly higher than transient wild ducks. Neither the goldfish nor the waterfowl inhabiting the pond attained concentrations of ^{137}Cs exceeding acceptable limits. Sediment, however, could be a source of high concentrations of radioactivity or radioactive contamination concern if the concentration of radiocontaminants increased and/or the pond dries up, and the contaminated sediments become windborne. (auth)

14279 (BNWL-1950(Pt. 3)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1974 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Part III. Atmospheric Sciences. Simpson, C. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1975. Contract AT (45-1)-1830. 287p. Dep. NTIS $7.60.

Separate abstracts were prepared for 11 sections of this report. A list is included of publications and presentations during 1974. (CH)

For abstracts of individual sections see: 14273, 14280–14283, 14294–14298, and 14318.

14280 (BNWL-1950(Pt.3), pp 216-221) RESUSPENSION OF PLUTONIUM AT ROCKY FLATS. Sehmel, G. A.; Lloyd, F. D. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research, Part III, Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

In a July, 1973 field experiment at Rocky Flats, vertical airborne plutonium (^{238}Pu and ^{239}Pu) concentration profiles were determined as a function of respirable particle size. The principal sampling site was a 30-m meteorological tower which was instrumented at several heights with self-orienting, high volume cascade impactor-cowl systems. Wind speed instrumentation activated selected impactors as a function of wind speed. Airborne plutonium concentrations and concentrations on airborne soil were measured as a function of both height and wind speed. Below 10 m, concentrations decreased with height. Above this height to 30 m, an increase suggested that an elevated upwind source could be contributing to the airborne concentration. The maximum airborne concentration measured was 3.7×10^{-15} Ci/m^3. The maximum concentration per gram of gross airborne soil was 50 pCi/g. All concentrations were far below the maximum permissible concentrations. (auth)

14281 (BNWL-1950(Pt.3), pp 221-223) POSSIBLE EXPLANATION OF APPARENT ANOMALOUS AIRBORNE CONCENTRATION PROFILES OF PLUTONIUM AT ROCKY FLATS. Sehmel, G. A. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research, Part III, Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Airborne samples of plutonium were analyzed for ^{238}Pu and ^{239}Pu isotopic content. These samples were obtained at elevations from 0.3 to 30 m above ground between the eastern security fence and cattle fence at Rocky Flats. Isotopic constituents were different at 30 m than for lower elevations, and samples of the higher elevations may represent a secondary source. (auth)

14282 (BNWL-1950(Pt.3), pp 223-225) RESUSPENSION OF RADIOACTIVITY INDUCED. Sehmel, G. A.; Orgill, M. M. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research, Part III, Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Airborne particulates from burning fields outside the Hanford reservation were sampled with an aircraft-mounted air filter.

Radioactivity concentrations in air samples collected from the smoke plume were compared to concentrations in ambient background air samples. Airborne concentrations of ^{7}Be and ^{95}Zr-Nb in the smoke were 1.2 to 4.6 times ambient background levels. (auth)

14283 (BNWL-1950(Pt.3), pp 237-239) ASSESSMENT OF THE LONG-TERM EXPOSURE DUE TO RESUSPENSION. Part II. Horst, T. W.; Elderkin, C. E. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part III. Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

An earlier model for the ratio between the exposure due to resuspension and the exposure due to direct atmospheric transport from a source is extended to account for radioactive decay of the hazardous material, and for a lower limit to the resuspension factor. These modifications are shown to affect the evaluation of the hazard of environmental release of plutonium only for a source which emits continuously for thousands of years. (auth)

14284 (NP-20456, pp vp Paper 17) PREOPERATIONAL AND OPERATIONAL ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS AROUND POWER REACTORS. Budnitz, R. J. (Univ. of California, Berkeley). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Pre-operational environmental monitoring programs are discussed with regard to goals, critical pathway studies, and preoperational background measurements. Operational environmental monitoring programs are discussed with regard to goals, measurement tasks, and the categories air, water, food, milk, biota, environmental dosimetry, instrumentation, and analytical requirements. (HLW)

14285 (NP-20456, pp vp Paper 18) MONITORING STRATEGY FOR ACCIDENTS. Selby, J. M. (Battelle Pacific Northwest Labs., Richland, WA). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The following topics are outlined: purposes of emergency environmental monitoring; characteristics of emergency environmental evaluation; differences between emergency and routine measurements; elements in emergency preparedness; utility action; emergency evaluation problems; and basic emergency evaluation instrumentation criteria. (HLW)

14286 (NP-20456, pp vp Paper 20) MEASUREMENT CONSIDERATIONS: DOSIMETRY. Thomas, R. H. (Univ. of California, Berkeley). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Radiation units are discussed with regard to exposure, absorbed dose, relationship between absorbed dose and exposure, RBE dose, and dose equivalent. Natural background radiation is discussed with emphasis on cosmic radiation and external gamma radiation. Radiation monitoring is discussed with regard to the use of ionization chambers, thermoluminescent dosimeters, and gamma spectrometers. (HLW)

14287 (NP-20456, pp vp Paper 23) EXPERIENCE WITH AN ONGOING OPERATIONAL ANALYSIS AND MONITORING PROGRAM. Van Wyck, R. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

An outline of the operational analysis and monitoring program includes the following topics: technical guidelines; technical specifications; nuclear environmental monitoring; results of nuclear environmental program; results of non-nuclear environmental program; nuclear environmental monitoring program for Indian Point; chemical effluent monitoring for Indian Point; water use summary; air and water pathways for releases; radiation doses to man; ^{131}I in milk; ^{134}Cs and ^{137}Cs distribution in river; Pu in Hudson River estuary; and fish impingement data. (HLW)

14288 (ORNL-5017) STATUS REPORT ON RADIOACTIVITY MOVEMENT FROM BURIAL GROUNDS IN MELTON AND BETHEL VALLEYS. Duguid, J. O. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 70p. Dep. NTIS $5.45.

The offsite radioactivity releases in the Clinch River from ORNL are less than 1 percent of the amount allowable for unrestricted use of the water by a population. However, studies directed toward locating sources of radioactivity release and toward seeking methods for reducing or eliminating them have been continued. Results are reported from a study, initiated in April 1973, concerned primarily with determining the radioactivity contributions to the Clinch River from the buried waste at ORNL and with implementing corrective measures. The groundwater transport of radionuclides, with emphasis on ^{90}Sr, from buried waste at Oak Ridge National Laboratory was measured. Estimates of ^{90}Sr discharge from the burial ground made from hydrologic data and groundwater monitoring show that 1 to 2 Ci of ^{90}Sr are transported from the burial ground annually. The amount of transport is directly related to precipitation, and stream monitoring data show that the discharge of ^{90}Sr from burial ground 4 has decreased over the past 11 years. Suggestions of engineering methods designed to decrease the ^{90}Sr discharge are made. (CH)

14289 (ORNL-EIS-75-21-5) ENVIRONMENTAL ASPECTS OF THE TRANSURANICS: A SELECTED, ANNOTATED BIBLIOGRAPHY. Faust, R. A.; Martin, F. M.; Sanders, C. T.; Talmage, S. S. (comps. and eds.). (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 234p. (NVO-AEIC-75-1). Dep. NTIS $14.75.

This fifth published bibliography of 594 references is from the computer file built to provide information support to the Nevada Applied Ecology Group (NAEG) of ERDA's Nevada Operations Office. The general scope is environmental aspects of uranium and the transuranic elements, with a preponderance of material on plutonium. In addition, supporting materials involving basic ecology or general reviews on other nuclides are entered at the request of the NAEG. Tables containing significant numeric data are referred to in the comment field. The references are arranged by subject category with first authors arranged alphabetically within the category. Indexes are given for author, keywords, geographic location, permuted title, taxons, and publication description. (auth)

14290 (PEL-239) MEASUREMENT OF RADIOACTIVE FALLOUT OVER SOUTH AFRICA DURING 1965–1973. van As, D.; Vleggaar, C. M.; van der Westhuizen, M.; Basson, J. K. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Jul 1974. 65p. Dep. NTIS (US Sales Only) $6.25.

A brief outline of the history of nuclear bomb testing prior to the 1962 moratorium on atmospheric testing, estimates of the resultant global inventories of long-lived fission products, global fallout trends and details of atmospheric tests conducted since 1964 are given. Against this background, details of the South African fallout monitoring program conducted by the Isotopes and Radiation Division of the Atomic Energy Board, analytical procedures and results of analyses of airborne fallout, deposited fallout, airborne moisture for ^{3}H, milk, maize, and human rib bone are presented. (auth)

14291 (SCPRI(RM)-11-1974) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Nov 1974. 11p. (In French). INIS.

This monthly report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U, and ^{3}H). A monthly bibliographic selection is also presented. (FR)

14292 (SCPRI(RM)-12-1974) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Dec 1974. 13p. (In French). INIS.

This monthly report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and ^{3}H). A monthly bibliographic selection is also presented. (FR)

14293 (SCPRI(RM)-12-1974(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Dec 1974. 24p. (In French). INIS.

Measurement tables concerning the surveillance of the environment (see also the SCPRI-RM-12-1974 report). (FR)

Atmosphere

14294 (BNWL-1950(Pt.3), pp 1-12) QUILLAYUTE AIR REFERENCE STATION. Ludwick, J. D.; Thomas, C. W.; Wendell, L. L.; Fox, T. D. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part III. Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A large number of radioactive and non-radioactive airborne constituents are being measured continually at the BNWL coastal air-reference station located in northwestern Washington State. Important correlations have been observed between many of these materials and also with atmospheric parameters. The apparent relationships between changing concentrations and meteorological parameters are being tested using more thorough techniques of investigation, including back trajectory computer analyses. Data are included on radionuclides, aerosol particle size and stable elements in daily air samples. (auth)

14295 (BNWL-1950(Pt.3), pp 13-16) METEOROLOGICAL CONSIDERATIONS IN THE INTERPRETATION OF THE TIME VARIATION OF RADIOACTIVITY AND CONCENTRATION OF OTHER POLLUTANTS. Fox, T. D.; Wendell, L. L.; Ludwick, J. D. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part III. Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Observations have shown that the major source region for atmospheric radionuclides and ozone is the stratosphere. If there is no significant low level source, such as a nuclear device detonation, high concentrations at the ground can occur only if there is a vertical atmospheric transport mechanism which moves these materials from high levels through the depth of the troposphere. Mechanisms of downward transport suggested by the preliminary data are summarized. A second group of atmospheric trace materials to be considered includes those whose source region is the earth. In studying the variations in concentrations of these materials, horizontal transport is the prime mechanism under consideration, although vertical movement may play a role. The variations in hourly condensation nuclei concentrations, and in daily lead (Pb) concentrations, are the records examined to date. A coarse examination of the data suggests that the lowest Pb and condensation nuclei concentrations are usually observed in a new air mass within two days of a frontal passage and that significant reductions in condensation nuclei concentrations corresponding to precipitation episodes indicate removal by scavenging. (CH)

14296 (BNWL-1950(Pt.3), pp 17-19) TRANSURANIUM ELEMENTS IN THE ATMOSPHERE. Thomas, C. W.; Perkins, R. W. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part III. Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The chemical and radiochemical composition of atmospheric aerosols is being measured to aid in assessing the present and future hazards to the environment presented by radioactive and nonradioactive contaminants. The rates and mechanisms by which airborne particles are mixed in the atmosphere and transported to and deposited on the earth's surface are also under study. This report describes the past introduction of radionuclides to the atmosphere resulting from nuclear weapons testing, the burnup of a navigational satellite, and by natural processes, and the behavior of these radionuclides after release. (auth)

14297 (BNWL-1950(Pt.3), pp 20-21) ATMOSPHERIC FALLOUT DURING 1974 AT RICHLAND, WASHINGTON AND POINT BARROW, ALASKA. Thomas, C. W. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part III. Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Concentrations of ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am have been measured in air samples taken at Richland, Washington, and Point Barrow, Alaska, since 1962, and the concentration of several other transuranium radionuclides estimated. During 1974, the concentrations of nuclear-weapons-produced radionuclides were 3 to 10 times times higher than those of 1973, as a result of the June, 1973, Chinese nuclear test. (auth)

14298 (BNWL-1950(Pt.3), pp 136-140) CIRRUS SCAVENGING AS A MECHANISM FOR THE PRODUCTION OF RADIONUCLIDE CONCENTRATION MINIMUMS BETWEEN 6 AND 9 KM. Young, J. A.; Wendell, L.; Wogman, N. A. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part III. Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The chemical and radiochemical composition of atmospheric aerosols is being measured to aid in assessing the present and future hazards to the environment presented by radioactive and nonradioactive contaminants. The rates and mechanisms by which airborne particulates are mixed in the atmosphere, and transported to and deposited on the earth's surface are also under study. One facet of this program involves the measurement of radionuclide concentrations above, below, and in cirrus. These measurements indicate that the scavenging of radionuclides by cirrus, followed by the settling of cirrus ice particles, may result in considerable transport of radioactivity. (auth)

14299 (NP-20456, pp vp Paper 21) SAMPLING TECHNIQUES: AIRBORNE. Matuszek, J. M. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The environmental monitoring program is outlined. Topics included under the heading meteorology are transport and diffusion. The following topics are included under the heading sampling requirements: particulates, vapors and aerosols, gases, and alternative sampling methods. Recent developments and experiences are outlined with regard to particulates, vapors, and gases. (HLW)

14300 (SCPRI(RM)-11-1974(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Nov 1974. 21p. (In French). INIS.

Measurement tables concerning the surveillance of the environment (see also the SCPRI-RM-11-1974 report). (FR)

14301 (UCID-16825) NUCLEAR ENERGY CENTER VS. DISPERSED NUCLEAR REACTORS: A COMPARISON OF DOSE ESTIMATION DURING AN ACCIDENTAL RELEASE TO THE ATMOSPHERE. Gudiksen, P. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract W-7405-Eng-48. 27p. Dep. NTIS $4.00.

An accidental release of radioactivity to the atmosphere from a nuclear power reactor demands rapid response to protect the health and safety of people in the vicinity. Techniques one may utilize to estimate, in real time, the environment impact and the dose-to-man from such an accident are described. Special emphasis is directed toward comparing the differences between estimates made in response to accidental releases from nuclear power reactors situated within a nuclear energy center (NEC) and to those occurring at an isolated, single nuclear power plant. For illustrative purposes the techniques developed at the Lawrence Livermore Laboratory (LLL) for the Atmospheric Release Advisory Capability (ARAC) are used as an example of how one may derive the dose estimates on a real-time basis. The ARAC concept is based on the latest developments in meteorological and radiological sensing systems, communications, data storage and retrieval, and data quality control in conjunction with the use of a suite of advanced atmospheric transport and diffusion models. The models have been validated against extended regional tracer experiments at the National Reactor Testing Station, Brookhaven National Laboratory, and the Savannah River Laboratory out to distances of 80 to 100 km. (auth)

Soil

Refer also to abstracts 14263, 14322, and 15023.

14302 (NP-20456, pp vp Paper 16) IMPACTS IN GROUNDWATER OF EFFLUENTS ARISING IN THE NUCLEAR INDUSTRY. Jacobs, D. G. (Oak Ridge National Lab., TN). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The following topics are discussed: modes of entry of radioactive wastes into groundwater; movement of radionuclides in the ground; degradation processes; behavior of tritium, ^{90}Sr, ^{137}Cs, ^{106}Ru and transuranic elements; potential pathways to man; and impact of releases of radioactive materials to the ground compared to radiation protection standards. (HLW)

14303 (ORNL-TM-4481) GEOCHEMICAL BEHAVIOR OF LONG-LIVED RADIOACTIVE WASTES. Gera, F. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 99p. Dep. NTIS $5.45.

The hazard potential associated with the heavy elements present in high-level radioactive waste decreases greatly in the first few tens of thousands of years of decay; however, further reduction in the hazard potential becomes extremely slow after about 100,000 years. In the time period between 100,000 and 5 million years the hazard potential of high-level waste is reduced by a factor of between 10 and 20. Current evidence seems to indicate that if radioactive waste containment were to fail after a period of 100,000 years or more, some environmental contamination would

result; however, the contamination levels would be low. The radiological risk would not be significantly different from that now existing in various localities as a result of the accumulation of natural radioactive elements. With the partial exception of radium, which is concentrated in the fruit of specific perennial plants, the long-lived alpha-emitters are characterized by very low biologic availability in terrestrial ecosystems. The biologic availability may be somewhat higher in aquatic ecosystems due to the significant reconcentration factors in particular organisms. Data concerning the levels of activity in foods grown on radioactive soils seem to confirm the low biologic availability of the natural radioactive elements. Surveys of uranium mill tailings indicate little dispersal of the radioactive elements into the environment; even though untreated tailings piles would appear to be particularly vulnerable to resuspension of dust particles by wind. (LK)

14304 (ORNL-tr-2989) DISTRIBUTION OF ^{210}Pb AND ^{226}Ra IN SOILS. Vilenskii, V. D. Translated by Martha Gerrard from Geokhimiya; No. 12, 1507-1510(1969). 10p. Dep. NTIS $4.00.

Studies of ^{210}Pb and ^{226}Ra distribution in soil specimens taken from four vertical sections in two districts of European USSR territory, showed that (calculated as air-dry specimens) the ^{210}Pb content was within the range of ~0.1 to 7.7 nCi/g and ^{226}Ra was 0.1 to 2.2 nCi/g. In the lower levels the ^{210}Pb content in soil was identical to the ^{226}Ra content, while in the upper levels it exceeded the ^{226}Ra content. The higher ^{210}Pb content indicated that the actual fallout was within 6.5 to 42.3 nCi/m^2 per day with the mean of 22 nCi/m^2 per day. (Previously announced in NSA from the original language as abstract 24:9496.) (auth)

14305 MIGRATION OF IONS IN SOILS. I. Movement of ^{65}Zn From Surface Application of Zinc Sulphate in Soil Columns. Singh, B. R. (Agricultural Univ., Aas, Norway). Plant Soil; 41: No. 3, 619-628(Dec 1974).

Plastic columns were uniformly packed with two different soils and subjected to percolation with different amounts of simulated precipitation after the addition of $ZnSO_4$ labelled with ^{65}Zn to the surface of each soil column. When drainage stopped, soil columns were frozen and cut into 3-cm segments, and radioactivity was determined with a well-type scintillator. Total Zn was calculated from activity counts. Soil samples were also analyzed for exchangeable Zn, Ca, and Mg. It is concluded that movement of Zn through soils depends not only on cation exchange capacity, but also on additional factors such as water flow-rate, pH, initial Zn content and the migration of other fractions of soils. (NL)

Water

Refer also to abstracts 13777 and 14276.

14306 (AECL-5039) TRITIUM IN LOWER PERCH LAKE BASIN. Barry, P. J.; Entwistle, F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1975. 38p. Dep. NTIS (US Sales Only) $5.00. AECL $1.00.

From a review of estimated tritium flows in the lower Perch Lake Basin and the observed changes in amounts of tritium stored in the ground water between 1963 and 1969, it has been shown that roughly two-thirds of the tritium released to the reactor pits reaches the lake within a few months by surface stream flow. The remaining one-third enters long-term storage in the ground water. The mean residence time in this reservoir appears to be at least ten years. (auth)

14307 (EC-SS-48) RADIONUCLIDE LEVELS IN THE GREAT LAKES WATERS, 1973. Durham, R. W. (Department of the Environment, Ottawa, Ontario (Canada)). 1974. 5p. INIS.

The only artificially produced radionuclides detected in the waters of the Great Lakes by γ spectrometry using a large volume Ge(Li) detector were ^{137}Cs and ^{125}Sb. The radioactivity levels of these radionuclides in the open waters of the lakes were measured during the spring and summer of 1973. Similar measurements were made at the plume-lake interface of the Ontario Hydro nuclear generating stations at Douglas Point and Pickering. The results of all the measurements were quite low with a range of 14 to 87 pCi m^{-3} for ^{137}Cs and 41 to 124 pCi m^{-3} for ^{125}Sb. (auth)

14308 RADIONUCLIDES IN WATER WORKS RESERVOIRS AND THEIR INFLUENCE ON LIVING ENVIRONMENTS OF MAN. Stanek, Z. (Water Conservancy Research Inst., Prague). pp 271-277 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Radioactivity levels in the Brno water reservoir in Czechoslovakia are discussed. The reservoir is being contaminated by ^{226}Ra and natural uranium from the uranium mines in the Dolni Rozinka area. It is estimated that the bottom sediments in the reservoir contain 3.7 tons of uranium, 3.2 tons of which are in the upper layers. Radiation dose rates are calculated for the waters above, in, and below the reservoir. (ERB)

14309 LATITUDINAL DISTRIBUTION AND ORIGIN OF PARTICULATE SILICA IN THE SURFACE WATER OF THE NORTH PACIFIC. Kido, K. (Hokkaido Univ., Hakodate, Japan). Mar. Chem.; 2: No. 4, 277-285(Dec 1974).

The concentrations of particulate silica and inorganic suspended matter in the surface water of the North Pacific were determined. The concentration of the particulate silica depends on latitude, and increases with increasing degree of the north latitude. The concentration of inorganic suspended matter shows a similar distribution pattern, but it is of much smaller magnitude. There exists a high positive correlation between the concentrations of particulate silica and nutrients. On the other hand, a weak negative correlation is found between the concentrations in surface seawater of particulate silica and radioactive ^{210}Pb which originate chiefly from precipitation and dry fallout. This evidence suggests that the particulate silica in the sea is mainly of biogenic origin and the contribution of nonbiogenic silica, i.e., of terrestrial origin, is small. (NL)

Ecosystems and Food Cycles

Refer also to abstracts 14593, 14614, and 14632.

14310 (AEC-tr-7606) RADIOECOLOGY OF WATER ORGANISMS. Vol. 2. Distribution and Migration of Radionuclides in Freshwater and Seawater Biocenoses. Andrushaitis, G. P. (ed.). 1973. Translation of Radioekologiya Vodnykh Organizmov. Vol. 2. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozkh, Zinatne, Riga, 1973. 199p. Dep. NTIS $7.60.

Separate abstracts were prepared from the original language for the 42 chapters of this book and appear as NSA 30:21082, 21083, 21101, 21110–21120, 21129–21151, 21354, 21422, and 21430–21433. (MCG)

14311 (EUR-5065f) STUDIES ON THE LEVELS OF RADIOACTIVE CONTAMINATION OF THE FOOD CHAIN AND THE ENVIRONMENT (1961–1971). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1974. 356p. (In French). Dep. NTIS (US Sales Only) $21.00. EURFB 1000,-.

A survey was made of research work carried out by the Euratom-J. R. C. Association from 1962 to 1971. The usual approach to the problem of radioactive contamination of the food chain and the environment is described and the environmental, dietary, and human physiological parameters, the main sources of production of artificial radionuclides, and their classification according to degree of human contamination via the food chain are reviewed. The ecological and agronomical factors determining the transfer of radioactive contamination from air, water, and soil and in food, and the transfer factors associated with food technology, were studied. The Association's research in the field of dietary surveys is surveyed and the food vectors responsible for radioactive contamination are listed. Much of the work done on the biological factors affecting man in Europe and a number of résumés of this subject are recapitulated. (auth)

14312 (NP-20456, pp vp Paper 22) SAMPLING OF WATER, FOOD, AND OTHER MEDIA. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The topics water, food, and other media are outlined with regard to typical sampling methods, sampling problems, and recommendations. Other media include soils, sediments, and biota. (HLW)

14313 (STH-12/74) STUDIES ON THE DETECTION OF ^{131}I IN FRESH COW MILK. Riedel, H.; Schwibach, J.; Winkelmann, I. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene). Nov 1974. 31p. (In German). INIS.

Using an anion ion exchanger (Dowex) and γ-spectrometric determination by means of a Ge(Li) detector a detection limit for ^{131}I in fresh cow milk of 0.2 pCi/l was obtained. In summer 1974 during two months 48 milk samples of 5 liters from the direct environment of the Gundremmingen reactor and, for comparative purposes, from the region of Munich were analyzed. In some samples traces of ^{131}I could be detected. (GE)

14314 COMPARISON OF ^{90}Sr AND ^{137}Cs INTAKE THROUGH FOODSTUFFS DURING THE PERIODS OF HIGHER AND LOWER

CONTAMINATION OF BIOSPHERE. Csupka, S.; Petrasova, M. pp 37-44 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Radioactive fallout is the primary source of contamination of the biosphere. The level of radionuclides in fallout plays the most significant role in surface contamination of the land and in absorption of radionuclides by foodstuffs. The level of ^{90}Sr and ^{137}Cs in the human diet makes it possible to estimate the radioactive body burden of these nuclides. Since the level of ^{90}Sr and ^{137}Cs differs in various kinds of food, the body burden depends also on the consumption rate of the particular kind of foodstuffs. The structure of the daily diet is different in various countries. There is a certain relationship between the contents of ^{90}Sr and ^{137}Cs in milk and radioactive fallout. The relationship between the levels of these two radionuclides in fallout and milk are expressed by the following correlation coefficients: 0.765 and 0.881 for ^{90}Sr and ^{137}Cs respectively. During the period of observation a gradual decrease of the amount of radioactive substances in fallout was found. For instance the contents of ^{90}Sr in fallout in 1972 reached only 9% of the value found in 1965. For ^{137}Cs this value was observed to be 26%. A similar decrease was observed also in the contents of these radionuclides in mild and other components of the daily diet. The ^{90}Sr contents in milk found in 1972 was only 32% of that in 1965 and in the total daily diet it was equal to 20%. The contents of ^{137}Cs in milk decreased to 22% and in the human daily diet to 12% respectively. In conclusion it may be stated that due to the changes in the structure of the daily diet during the recent years, the ratio of the ^{90}Sr in the total diet and milk has markedly changed. As a result of this it is impossible to estimate reliably the ^{90}Sr and ^{137}Cs intakes by the daily diet from their contents in milk. (ERB)

14315 RELATIONSHIP BETWEEN RADIOACTIVE FALLOUT AND THE ^{90}Sr AND ^{137}Cs CONTENT IN CEREALS. Csupka, S.; Petrasova, M. (Krajska Hygienicke Stanics, Bratislava). pp 45-52 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

For assessment of ^{90}Sr and ^{137}Cs in cereals, samples of wheat and barley from one year crop were taken at four locations in western Slovakia. The average values of these two radionuclides in fallout and in the cereals are given. The direct correlation between the ^{90}Sr and ^{137}Cs levels in fallout and in cereals is apparent. (ERB)

14316 COMPUTER SIMULATION OF ^{131}I TRANSFER FROM FALLOUT TO MAN. Soerensen, B. (Niels Bohr Institutet, Copenhagen). Water, Air Soil Pollut.; 4: No. 1, 65-87(Mar 1975).

A compartment model was constructed to depict the principal routes of ^{131}I transfer from fallout to man. Thyroid accumulation and excretion have been modelled for cow and for man. A simulation is carried out of the major fallout during the fall of 1962, following tests of nuclear weapons, and the results are compared with experimental data for southern Scandinavia. (NL)

14317 KONTAMINATION AND DEKONTAMINATION VON LEBENSMITTELN. Bericht Ueber das Symposium der Arbeitsgruppe Strahlenschutz in der Ernaehrungswirtschaft. (Contamination and Decontamination of Food. Proceedings of the Symposium of the Arbeitsgruppe Strahlenschutz in der Ernaehrungswirtschaft). Fischer, E. (comp.). Bonn-Bad Godesberg, F. R. Germany; AID - Land- und Hauswirtschaftlicher Auswertungs- und Informationsdienst e.V. (1974). 339p. (In German).

Available from ZAED.

The present report contains 23 lectures which were held in the year 1970 on the occasion of the symposium of the same name of the radiation protection work group in food economy. They are concerned with the causes and types of radioactive contamination of food and with the behavior and effect of radionuclides in food. Further main topics are the possibility of influencing the contamination by the appropriate measures and decontamination. Some lectures deal with analytics and instrumentation. (GE)

Radiometric Techniques

Refer also to abstract 14266.

14318 (BNWL-1950(Pt.3), pp 184) DETERMINATION OF AEROSOL DEPOSITION RATES ON A LAKE SURFACE USING RADON DAUGHTERS. Young, J. A. Feb 1975.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part III. Atmospheric Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The chemical and radiochemical composition of atmospheric aerosols is being measured to assist in assessing present and future hazards to the environment presented by radioactive and nonradioactive contaminants. The rates and mechanisms by which airborne particulates are mixed in the atmosphere and transported to and deposited on the earth's surface are also under study. The concentrations of the radon daughters ^{214}Pb and ^{214}Bi were measured in the atmosphere and in Lake Crescent water in conjunction with wind speed measurements to determine the rate of turbulent deposition of atmospheric aerosols on the lake surface as a function of wind speed. (auth)

14319 ISOTOPE RELATION OF $^{234}U/^{238}U$ IN THE SUBTERRANEAN WATERS IN SOUTHERN GEORGIA. Dolidze, N. I.; Zverev, V. L.; Spiridonov, A. I.; Cheshko, A. L.; Chkhenkeli, Sh. M. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 78: No. 2, 385-388(May 1975). (In Russian).

The anomalous high values of the relation of U^{234}/U^{238} in the subterranean waters in seismoactive regions of southern Georgia are given. (auth)

14320 CLIMATIC CYCLES. Moerner, N. A. (Univ. of Stockholm). J. Interdiscip. Cycle Res.; 6: No. 1, 15-24(Jan 1975).

Much progress has been made in the calibration of radiocarbon chronology to an absolute chronology. Therefore it is now possible to find a certain cyclicity in climatic-geological records by calculation. Both long and short cycles appear to be irregular. (NL)

14321 Rb-Sr ISOCHRONS FOR THE GRANITIC PLUTONS AROUND FARSUND, SOUTHERN NORWAY. Pedersen, S.; Falkum, T. (Univ. of Copenhagen). Chem. Geol.; 15: No. 2, 97-101(Apr 1975).

The granitic and charnockitic intrusions in the Precambrian migmatites around Farsund in southern Norway have previously been shown to be successively intruded as well as being geochemically different. Rb- and Sr-isotope data support the conclusion that they are intruded with a separate time interval and that the Farsund charnockite is younger (852 ± 41 m.y.) than the Lyngdal hornblende granite (932 ± 38 m.y.). Furthermore, the different initial ratios (0.7128 and 0.7054, respectively) disprove a comagmatic origin unless largescale contamination has occurred. (NL)

14322 MIGRATION OF IONS IN SOILS. II. Movement of ^{54}Mn from Surface Application of Manganese Sulphate in Soil Columns. Singh, B. R. (Agricultural Univ., Aas, Norway). Plant Soil; 41: No. 3, 629-636(Dec 1974).

Movement of ^{54}Mn from surface application of manganese sulphate in soil columns was investigated after leaching with different amounts of rain water. Alternate leaching and drying affected the depth of penetration of Mn. The presence of Zn cation had no appreciable effect on the distribution of Mn in the soil columns. Exchangeable Mn displayed distribution patterns similar to total Mn. Mn movement in soil not only depends on cation exchange capacity and clay content, but also involves other factors such as water-flow-rate, pH, migration of clay fractions and oxidation reduction conditions. (NL)

14323 SUBSURFACE FLOW FROM SNOWMELT TRACED BY TRITIUM. Martinec, J. (Federal Inst. for Snow and Avalanche Research, Davos, Switzerland). Water Resour. Res.; 11: No. 3, 496-498(Jun 1975).

An explanation is offered of the apparent discrepancy between the small velocities of subsurface flow and the watershed response. Environmental tritium in the hydrological cycle provided evidence for a new insight into the runoff mechanism. By this concept the quick reaction of outflow to a massive groundwater recharge is brought to agreement with the long residence time of the infiltrated water. (auth)

14324 ENRICHMENT OF RADIOCARBON FOR DATING SAMPLES UP TO 75,000 YEARS. Grootes, P. M.; Mook, W. G.; Vogel, J. C. (Rijksuniversiteit Groningen (Netherlands). Natuurkundig Lab.); de Vries, A. E.; Haring, A.; Kistemaker, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Z. Naturforsch., A; 30: No. 1, 1-14(Jan 1975).

The range of the radiocarbon dating method can be extended by about 20,000 years by means of thermal diffusion isotopic enrichment. A description of the Clusius-Dickel type enrichment columns and their operation is given. Prior to enrichment the carbonaceous sample material is combusted to CO_2 and then

reduced to CO. The enriched sample is re-oxidized to CO_2. The combustion-, reduction-, and oxidation-apparatus and their operation are described. The performance of the thermal diffusion columns has been tested and an empirical volume independent relation between the isotope separation factors of $^{14}C^{16}O$ and all molecules with mass around 30 is given: $q^{14} - 1 = (1.13 \pm 0.05)(q^{30} - 1) + (0.035 \pm 0.005)(q^{30} - 1)^3$. The influence of contaminations on the reliability of ^{14}C dates obtained with this method is discussed. Laboratory contaminations can be kept below the detection limit as is shown by the preparation of two anthracite samples. Still there may be some influence on dates obtained for very old samples. As far as laboratory contaminations are concerned, dates up to 75,000 years can be obtained. (auth)

14325 ACCURACY OF DATES BEYOND THE ^{14}C DATING LIMIT USING THE ASPARTIC ACID RACEMISATION REACTION. Bada, J. L.; Deems, L. (California Univ., La Jolla, San Diego). Nature (London); 255: No. 5505, 218-219(15 May 1975).

Recent evidence seems to suggest that the racemization reaction of aspartic acid in bones can be used to date fossil bones. The half-life for the reaction is ~15,000 years at 20°C and because this is longer than the half-life of ^{14}C the reaction can be used to date bones that are beyond the ^{14}C dating limit, that is, more than 40,000 years old. Furthermore only a few grams of bone are required for the determination, and thus bones available in insufficient quantities for radiocarbon dating can be dated from the extent of aspartic acid racemization. A technique for carrying out the dating is described. This consists of "calibrating" the rate of the racemization reaction using the extent of racemization in a bone dated by radiocarbon. Once this calibration has been carried out for a particular site other bones from the site can be dated from the extent of their racemization. Results suggested that a bone that has a radiocarbon age of 18,000 to 20,000 years is a suitable calibration sample for dating older bones. Ages derived using racemization are in very close agreement with those deduced from other evidence. The extent of racemization of aspartic acid in the bones was determined using procedures described by the author in Proc. Natl. Acad. Sci., USA; 70: 1331(1973). Results from various bone samples are discussed. (UK)

14326 SOILS WITH MONTMORILLONITE OF THE TROPICAL HUMID ZONE OF BAHIA. Paleoclimatic Meaning. Conceicao, T. M. L. (Univ. Federal da Bahia, Salvador, Brazil); Oliveira, J. J.; Moniz, A. C.; Sieffermann, G. (Cah. ORSTOM, Ser. Pedol.; 12: No. 2, 137-143(1974). (In French).

From 4th Latin-American congress on soil science; Maracay, Venezuela (12 Sep 1972).

Moderately thick soils of the ILHEUS region (Bahia) formed from granulites under tropical humid climate were studied. A brief description of the soils and their characteristics are presented. The clay fraction was studied in detail by x-ray-diffraction and electron microscopy. The clay minerals were shown to be montmorillonite which constitutes the major part and disordered kaolinite. In a few profiles there were halloysite and metahalloysite. Isotopic measures $^{14}C/^{12}C$ on a profile gave data concerning the rate of mineralization and biological activity. This type of alteration in a tropical humid zone is interpreted as resulting from a much drier climate than the present day climate, and suggests that there was a large increase in rainfall in the recent past. (FR)

Site Surveys

Refer also to abstracts 14284 and 16565.

14327 (JUL-1142-ST) METEOROLOGICAL CLASSIFICATION OF SITES IN THE GERMAN FEDERAL REPUBLIC AS A BASIS FOR ENVIRONMENTAL PROGNOSES FOR NUCLEAR FACILITIES. Brenk, H. D.; Vogt, K. J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Strahlenschutz). Dec 1974. 88p. (In German). INIS.

Theoretical diffusion and meteorological bases for a long-term prognosis model of the environmental impact due to radioactive nuclides with special regard to the site problems of nuclear facilities were compiled. Regions with similar diffusion properties are summarized into so-called regional siting classes, for which a wind directional and source distance-dependent long-term diffusion function valid for this class is given that takes into account the site specific diffusion conditions in the average regional and long-term values. It is thus possible to calculate the annual dose to be expected for each site in the Federal Republic of Germany and thus to estimate the future radiation burden to the population. The wind directional dependent long-term diffusion functions can be calculated for each site within the two basic site classes. Basic site classes can be subdivided into four further classes, so that one comes to a total of nine meteorological site classes including West Berlin for the Federal Republic of Germany. (GE)

14328 (TID-3353) ENVIRONMENTAL STUDIES AT THE SAVANNAH RIVER PLANT AND IMMEDIATE ENVIRONS. A Bibliography. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jul 1975. 99p. Dep. NTIS $5.45.

Energy Research and Development Administration-sponsored environmental research papers pertinent to the region are listed. The 702 citations are arranged by category. Citation arrangement within categories is by reports, in report number order, followed by books and journal articles in chronological order. For those references previously announced in Nuclear Science Abstracts, the Volume and Abstract Number are given at the end of the citation. Two indexes are provided: Personal Author and a KWIC Subject Index based on titles of the citations. (MCG)

14329 NATIONAL WATER COMMISSION: PROBLEMS AND ISSUES. Liebman, E. (National Water Commission, Washington, DC). Natur. Resour. Lawyer; 5: No. 4, 640-667(Fal 1972).

Some of the major water policy problems and issues being confronted by the National Water Commission are discussed. Topics covered include: the role of water in society, future economic demands for water and water-related services, institutional arrangements, the cost of water programs and who should pay for them, and basic data and research. (MCG)

14330 LITTORAL DRIFT ALONG THE NORTHWESTERN COAST OF TARANTO GULF (SOUTHERN ITALY). Brondi, A.; Ferretti, O.; Anselmi, B. (CNEN, Milan). Rend. Soc. Ital. Mineral. Petrologia; 30: 111-140(Jun 1974). (In Italian).

The Laboratorio Geominerario of CNEN carried out several researches both on the continent and in the sea for the siting problems related to the nuclear plants of the CRN of Trisaia. A particular study was directed to the recognition of local littoral drift. This might allow foreseeing the possible dispersion pattern of radioactive effluents, freely or casually released from the above mentioned nuclear plants. This research was based on the spatial relationship among the fluvial, beach, and perilittoral sands in the coastal band extended between the Crati mouth southerly and Taranto town northerly. Three main littoral zones, strictly related to different mineralogical composition of local rivers, were recognized by means of mineralogical analysis. The granulometric analysis permitted also to distinguish a southern part, generally, subjected to erosion and a northern part with prevailing sedimentation. The observations demonstrated on the whole a clear, though moderate, general drift of sandy materials from SO to NE. (auth)

Thermal Effluents

Refer also to abstracts 14274, 14337, 16557, and 16558.

14331 (COO-3062-20) DISTRIBUTION OF EXCESS TEMPERATURE FROM THE VIENNA GENERATING STATION ON THE NANTICOKE RIVER. Technical Report 90. Carter, H. H.; Regier, R. J. (Johns Hopkins Univ., Baltimore, Md. (USA). Chesapeake Bay Inst.). Jun 1975. Contract AT(11-1)-3062. 60p. Dep. NTIS $5.45.

Temperature and dye tracer data, collected in the Nanticoke River in the vicinity of the Delmarva Power and Light Company Vienna fossil-fuel power plant between 12 and 26 April 1974 were analyzed and interpreted in terms of the distribution of excess temperature as a function of tidal phase. Cooling water flows and plant recirculation were also determined. (auth)

14332 (NP-20456, pp vp Paper 12) THERMAL PLUME ANALYSIS. Shirazi, M. A. (Environmental Protection Agency, Corvallis, OR). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

A comprehensive background and some results based on mathematical models of thermal plumes for surface and submerged jets are presented. Topics covered include: conservation laws, plume models, integral analysis, dimensional analysis, deep submerged discharge, and surface discharge. (MCG)

14333 (NP-20456, pp vp Paper 14) IMPACTS OF THERMAL AND CHEMICAL DISCHARGES TO SURFACE WATER. Stober, Q. J. (Univ. of Washington, Seattle). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Various aspects of thermal and chemical discharges to surface water are outlined. The major impacts of nuclear power plants on

aquatic resources are disruption during construction, intake of cooling water, discharge problems, and interactions with other water users. The following topics are included under the heading, assessment of aquatic ecology: identification of flora and fauna; abundance of aquatic organisms; species-environment relationships; and identification of pre-existing environmental stress. The following topics are included under the heading, environmental effects of plant operation: entrapment of fish by cooling water; passage of plankton through cooling system; discharge area and thermal plume; chemical effluents; and plant construction. (HLW)

14334 (NP-20488-P1) ENVIRONMENTAL MONITORING AND ECOLOGICAL STUDIES PROGRAM. 1974 Annual Report for the Prairie Island Nuclear Generating Plant Near Red Wing, Minnesota. Volume I. (Northern States Power Co., Minneapolis, Minn. (USA)). Jun 1975. 518p. Northern States Power Co., Minneapolis, MN.

Data are presented from studies on the effects of thermal effluents from the Prairie Island nuclear power plant on water temperature and primary productivity of phytoplankton in the Mississippi River downstream from the site. Results of measurements showed that plant-heated waters had dropped to near normal temperatures at the end of the discharge canal. The size and shape of the thermal plume at Prairie Island were determined. The chemical composition of water samples collected upstream was compared to that of samples collected downstream from the plant. Plankton species and seasonal succession patterns were characterized both at the plant site and downstream from the plant for any evidence of changes resulting from plant operations. The effects of entrainment of plankton in the cooling water system were also studied. Data are included on invertebrates in water samples collected at various locations. (CH)

14335 (NP-20488-P2) ENVIRONMENTAL MONITORING AND ECOLOGICAL STUDIES PROGRAM. 1974 Annual Report for the Prairie Island Nuclear Generating Plant Near Red Wing, Minnesota. Volume II. (Northern States Power Co., Minneapolis, Minn. (USA)). Jun 1975. 520p. Northern States Power Co., Minneapolis, MN.

Data are presented from studies on the effects of thermal effluents from the Prairie Island nuclear power plant on fish and invertebrate populations in the Mississippi River in the vicinity of the plant. Populations of aquatic and terrestrial plants and birds in the immediate vicinity of the plant were also characterized. (CH)

14336 ENVIRONMENT AND NUCLEAR ENERGY. III. Environmental Considerations on Heat Release. Wright, J. H. Energ. Nucl. (Madrid); 19: No. 93, 39-42(1975). (In Spanish).

The environmental impact of thermal release from nuclear power plants is studied. The thermal yields from various thermal sources, such as modern fossil-fuelled power plants, nuclear power plants, gas turbines, and automotive systems, are compared and data on the quantity of heat discharged to the environment by these sources are proportioned. The effects of thermal pollution of coolant water on the biota of the aquatic system are analyzed. The effects which depend on the specific characteristics of each system are also analyzed. The long-term effects of thermal discharge are analyzed both from the viewpoint of the entire planet and from the local level. These effects are compared with those produced by a decrease of the capacity of the earth to radiate heat to space because of the increase of the CO_2 content in the atmosphere. (tr-auth)

Chemical Effluents

Refer also to abstracts 14274, 14279, 14294, 14295, 14333, and 16558.

14337 (NP-20456, pp vp Paper 6) ENVIRONMENTAL EFFLUENTS FROM WASTE HEAT REJECTION. Becker, C. D.; Thatcher, T. O. (comps.). (Atomic Energy Commission, Washington, DC). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The occurrence of chemicals in the cooling water discharge from nuclear power plants is discussed. Chemicals associated with nuclear power plants are tabulated. In one table they are classified under the following headings: corrosion and scale inhibitors; corrosion products; cleaning and neutralizing compounds; and biocides. In a second table they are classified as follows: acids; acrolein; arsenates and arsenites; ammonia, amines, and related compounds; boron; carbonates; chlorine and bromine; chlorinated and phenylated phenols; chromates; cyanurates and cyanides; hydrazine compounds; hydroxides; metals and their salts; nitrites and nitrates; potassium compounds; phosphates; silicates; and sulfates and sulfides. (HLW)

14338 POLLUTION: A PROBLEM OF THE FUTURE. Bertolini, G. Anal. Prevision.; 18: No. 4, 475-506(Oct 1974). (In French).

The content of the thesis that pollution should be a problem for the future is specified. There are now local problems. There shall occur a change as to the scale of the problems; the ability to overcome them shall depend on changes in social structure rather than technological progress. (FR)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 14286.

14339 (CONF-731166-) 3rd SYMPOSIUM ON RELIABILITY IN ELECTRONICS, NOVEMBER 13–16, 1973, BUDAPEST, HUNGARY. (Magyar Tudomanyos Akademia, Budapest). 1973. 476p. (In several languages).

From 3rd symposium on reliability in electronics; Budapest, Hungary (13 Nov 1973).

Thirty-nine papers were presented at the conference. A separate abstract was prepared for one paper. The remaining papers are not in scope for NSA. (TFD)

For an abstract of an individual paper see: 14371.

General Detectors and Monitors

Refer also to abstract 14429.

14340 (CEA-CONF-2901) AN X-RAY LOCALIZATION METHOD WITH HIGH SPACE RESOLUTION: DESCRIPTION AND PERFORMANCE OBTAINED. Allemand, R.; Thomas, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 6 Nov 1974. 18p. (In French). INIS.

From 3rd Colloquium on x-ray analytical methods; Nice, France (16 Sep 1974).

The position-sensitive system described uses electrical signals induced on the cathode elements of a monofilament or multifilament proportional chamber. The induced signals used for localisation are obtained by dividing up the cathode into several elementary surfaces. An original pattern referred to as the backgammon partition is proposed here: if the cathode cylinder is developed, the two half-cathodes take the form of two overlapping rectangle triangles. It is shown that the physical localisation limits of the system for argon-methane and xenon-methane mixtures correspond to separating powers of 30 μm and 20 μm respectively. This system is applied in x-ray diffraction, and even in neutron diffraction in association with a convertor gas (BF_3, ^3He). The advantages lie in the sturdiness of the detector (gilded tungsten filaments standing up perfectly to long exposure in the main beam of an x-ray generator), the simplicity of the position calculation and the possibility of adaptation to different forms of detector medium. (FR)

14341 (CEA-CONF-2956) ACTIVITIES OF THE ELECTRONICS AND COMPUTER TECHNOLOGY LABORATORY IN BIOMEDICAL ENGINEERING. Gariod, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 4 Sep 1974. 17p. (In French). INIS.

From international exhibition Zdravookhramente 74; Moscow, USSR (28 May 1974).

Methods and instruments are studied at the Electronics and Computer Research Laboratory of the Commissariat a l'Energie Atomique - Centre d'Etudes Nucleaires Grenoble in collaboration with medical teams and to some extent with industry responsible for the development of equipment. Some investigations are described: study of ocular movements; measurements of a blood flow index in the members; detectors for nuclear images; processing of γ camera images; and electronystagmography. (FR)

14342 (EGG-1183-2123) EFFECT OF INTERNAL ELECTROMAGNETIC FIELDS ON COMPTON DIODE RESPONSE. Stevens, J.; Artuso, J. F. (EG and G, Inc., Santa Barbara, Calif. (USA)). 12 Dec 1966. 56p. Dep. NTIS $6.00.

The nominally 50-psec-wide 10-MeV electron beam of the AEC/EG&G linac was used to measure the response function of the L-22 Compton detector and to compare it with the response of other detectors. These measurements revealed that when gamma rays impinge on the detector, they release bursts of electrons which generate electromagnetic radiation inside the detector cavity, resulting in high-frequency oscillations in the output signal. Preliminary evidence indicates that this internal EMP effect, which will appear when a cavity is subjected to a burst of gamma radiation, may result when a charged particle makes a transition from one medium to another. The maximum frequency radiated under these conditions is determined by the requirement that the electron burst act coherently. If this maximum frequency is comparable to the resonant frequencies of the cavity, a large signal will be produced. Additional study of this effect, which has not been observed by other investigators, is recommended. (auth)

14343 (GSI-J-2-74, pp 54-59) AgCl-PARTICLE TRACK DETECTOR. Schopper, E.; Schott, J. U.; Staudte, R.; Bloching, S.; Muth, W. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Evaluation methods are reported for AgCl nuclear track detectors by electronic track analysis. Measurements of track evaluation are given and discussed. (GE)

14344 (IFVE-OP-74-18) MULTIWIRE PROPORTIONAL CHAMBER WITH INTEGRATED CIRCUITS. Alekseev, A. V.; Borisov, A. A.; Glebov, V. Yu.; Gubrienko, K. I.; Kuznetsov, V. S.; Yampol'skij, I. R. (Gosudarstvennyj Komitet po Ispol' zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 8p. (In Russian). INIS.

A wire proportional chamber that is used to determine the profile of a beam of secondary particles is described. Analogue information from each wire is remembered on an inlet capacitor, is amplified by a two-cascade amplifier with a large inlet resistance, and subsequently, is brought out to an oscillograph having a memory by linear keys which are controled by single vibrators. (SJR)

14345 (NP-20343, pp 108-110) NEUTRON MULTIPLICITY COUNTER. Trautmann, N.; Ahrens, H.; Kaffrell, N.; Tharun, U. 15 Jun 1974. (In German).

In annual report, 1973.

14346 HOW MUCH LIGHT FROM RECTANGULAR SCINTILLATION COUNTERS. Smith, T. (Medical Research Council, London). Phys. Med. Biol.; 20: No. 2, 282-295(Mar 1975).

Theoretical calculations have been made of the efficiency and uniformity of light collection at one end of a large rectangular liquid scintillation counter (80 × 20 × 18 cm). Three different arrangements were considered; (1) a system in which all surfaces of the counter other than the collecting surface were transparent to permit total internal reflection, (2) a similar system with a mirror placed close to the end opposite the collecting surface, and (3) a system in which external reflectors were placed close to surfaces other than the collecting surface. In all cases, the effects of attenuation of light in the counter medium, inefficient total internal reflection, and the reflectivities of external reflectors were considered and illustrated for selected values of these parameters. In an experimental counter of the same dimensions, the amplitude of the spectrum of a collimated ^{42}K source was used to measure the relative efficiencies of light collections for various reflector arrangements. In general the experimental values agreed with the theory and the non-uniformity of response was within the predicted range. It was estimated that about 30% of scintillation light could be collected at one end of such a counter, with a non-uniformity not greater than 10%, if magnesium oxide was used as the external reflector at all other surfaces. (auth)

14347 MONTE CARLO CALCULATION OF THE ABSOLUTE MAXIMUM DETECTION EFFICIENCY OF A CYLINDRICAL GAMMA RADIATION DETECTOR. Green, M. V.; Aamodt, R. L.; Johnston, G. S. (National Inst. of Health, Bethesda, MD). Health Phys.; 28: No. 5, 624-628(May 1975).

The absolute efficiency of cylindrical γ radiation detectors depends on the size and composition of the detector, the energy of the photon emitted by the source and on the position of the source relative to the detector. The method of computing three efficiencies by a modified Monte Carlo program is discussed. These efficiencies are: (1) the geometric efficiency; the fraction of photons emitted by the point-source that impinge on the detector, (2) the fractional efficiency; the fraction of photons impinging on the detector that interact with the detector, and (3) the absolute maximum efficiency; the fraction of photons emitted by the source that interact with the detector. (UK)

14348 HIGH SENSITIVITY DUAL-DETECTOR SHADOW-SHIELD WHOLE-BODY COUNTER WITH AN "INVARIANT" RESPONSE FOR TOTAL BODY IN VIVO NEUTRON ACTIVATION ANALYSIS. Boddy, K.; Elliott, A.; Robertson, I.; Mahaffy, M. E.; Holloway, I. (Scottish Research Reactor Centre, East Kilbride, Eng.). Phys. Med. Biol.; 20: No. 2, 296-304(Mar 1975).

The development of a dual-detector shadow-shield whole-body counting system of high sensitivity is described. The sensitivity

and performance of the counter were analyzed, with specific references to total body in vivo neutron activation analysis and shown to be at least comparable with those of many conventional shielded-room counters. (auth)

14349 PERSONAL CONTAMINATION MONITOR USING LARGE AREA GEIGER COUNTERS. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys.; 28: No. 5, 521-527(May 1975).

Organic quenched Geiger counters can be made with fillings at near atmospheric pressure which permits the use of large area (250 cm^2), thin (7 mg/cm^2) windows. This construction facilitates the detection of low energy (0.3 MeV maximum energy) β emitters spread over hands and shoes. These counters have a limited life (~10^8 counts) but this limitation has been overcome by biassing them only during the counting process, minimizing the counting period and reducing the background with 25 mm of lead shielding. The monitor employs such counters for detecting permissible levels (0.1 nCi/cm^2 over 300 cm^2 for β-emitters of maximum energy 0.3 MeV or more) on hands or shoes. For contamination on other surfaces, such as the face, clothes or tools, a similar but smaller (50 cm^2) counter is mounted into the probe. A simple system of indicator lamps is used to show the presence or absence of excessive contamination. When contamination is detected its level can be estimated with a digital display count rate meter (0 to 2000 counts/sec). (auth)

14350 HIGH-SENSITIVITY, HIGH-RESOLUTION, DIVERGING COLLIMATOR FOR USE WITH LOW ENERGY ISOTOPES. Causer, D. A.; Taylor, C. G. (Univ. of Aberdeen, Eng.). Phys. Med. Biol.; 20: No. 2, 318-320(Mar 1975).

The restricted field of view of most commercial gamma cameras presents problems when lungs and liver are to be scanned. A parallel hole collimator gives a field of view which will not usually encompass both lungs in one anterior or posterior scan. An improved collimator was therefore designed and constructed. The collimator was lead formed into tapered channels of square cross section with narrow septa. The resolution and sensitivity were assessed. Under clinical conditions both lungs could be imaged at once, or the whole of the liver and spleen could be visualized in a single anterior or posterior view. Although originally designed for use with ^{99m}Tc, the collimator had sufficient sensitivity for use in ^{133}Xe ventilation scans, and could therefore be used on one patient for both purposes, thus eliminating the need to change the collimator. (UK)

14351 SENSITIVITY OF PORTABLE BETA-GAMMA SURVEY INSTRUMENTS. Sommers, J. F. Nucl. Saf.; 16: No. 4, 452-457(1975).

Development of a new generation of portable radiation survey instruments and application of the "as low as practicable" (ALAP) philosophy have presented a problem of compliance with guides for radioactive contamination control. Isolated, low-level, discrete-particle beta-gamma contamination is being detected with the new instruments. To determine the limits of practicability requires, in turn, the determination of the limits of detection of these surface contaminants. The data and calculations included in this article indicate the source detection frequencies that can be expected using the new generation of survey instruments. It is concluded that, in low-population groups of discrete particles, about 5000 dis/min of beta activity per particle is the minimum level of activity per particle which is applicable for confident compliance with surface contamination-control guides. Lower control levels are possible with additional development of instruments or through high-cost changes in radiation survey and contamination-control methods. Additional analyses are required for assessment of the hazard caused by widely dispersed discrete-particle contaminants. (auth)

14352 ELECTRICAL CHARACTERISTICS OF AN X-RAY PHOTOELECTRON SPECTROMETER. McGilp, J. F.; Main, I. G. (Liverpool Univ. (UK)). J. Electron Spectrosc. Relat. Phenom.; 6: No. 5, 397-409(May 1975).

Current-voltage characteristics have been measured for an AEI ES200B X-ray photoelectron spectrometer with both conducting and insulating samples. With the conducting sample, the flux of secondary electrons falling on the specimen and probe amounts to approximately 20 percent of the photoelectron flux, over a wide range of irradiation conditions. The results from the insulating sample, taken in conjunction with subsidiary data from charging shifts, indicate that the secondary flux incident on the specimen alone exceeds 99 percent of the photoelectron flux. (auth)

14353 A DEVICE FOR STABILIZING THE GAIN OF A RADIATION DETECTOR. Seeman, Bronislav. (to Societe de Prospection Electrique Schlumberger, 75 – Paris (France)). French Patent 2,211,664/A/. 21 Dec 1972. 18p. (In French).

Description is given for stabilizing the gain of a radiation detector or sensor comprising a radiation-source capable of acting upon said detector so as to provide reference peaks in the spectrum of its output pulses, first means for sensing the movements of said peaks following a gain change and generating an error-signal, the amplitude and sign of which are representative of the extend and sign of these movements respectively, and second means responsive to said signal adapted to correct these movements. In order to make it possible to use a low-activity source without decreasing the response velocity to gain changer, third means are provided between said first and second means for amplitude modulating the error signal according to a function of amplitude, said function being a function with a derivative the absolute-value of which increases from the origin. This device can be used for stabilizing the gain of photomultipliers. (FR)

14354 DEVELOPMENT OF A DATA ACQUISITION AND PROCESSING SYSTEM IN NUCLEAR MEDICINE. Bitter, F. Ulm, Ger.; Univ. Ulm (1972). 73p. (In German). INIS.

Thesis.

The paper describes the development of a system for acquisition of data from a scintillation camera and from other measuring instruments in nuclear medicine. This system allows a quantitative evaluation of studies of performance. As it makes the highest demands and provides the most data, radiocardiography was used as an example of the utilization of the complete system. The author made a point of making the system as simple and easy to handle as possible for practical use in order to avoid sources of error due to the varieties of technical apparatuses used. The system is utilized not only for research but also for routine diagnostics. (auth)

14355 A SIMPLE FAST-NEUTRON DETECTOR WITH PULSE DISCRIMINATION AGAINST GAMMA RAYS. Dewendra, J. D.; Galloway, R. B. (Edinburgh Univ. (UK)). Nucl. Instrum. Methods; 125: No. 4, 503-505(1 May 1975).

The satisfactory neutron detection attainable with an NE 213 liquid scintillator and a simple 11-stage photomultiplier employing the Owen technique of pulse-shape discrimination is demonstrated. Suitable circuitry for use with the detector is given and can be contained within a single-width NIM module, making the system particularly suitable for multi-detector experiments in which fast timing is not essential. (auth)

14356 EFFICIENCY CALIBRATION OF A Ge(Li) DETECTOR BY ABSOLUTE COUNTING OF FALLOUT NUCLIDES BY MEANS OF THE 4π β-γ COINCIDENCE METHOD. Weinreich, R. (Mainz Univ. (F.R. Germany). Inst. fuer Anorganische Chemie und Kernchemie). Nucl. Instrum. Methods; 125: No. 4, 601-603(1 May 1975).

The $4\pi\beta$-γ coincidence method proves to be very suitable for absolute counting of fallout nuclides. Using such nuclides, absolute calibration of a Ge(Li) detector was carried out for different geometry positions. (auth)

14357 CALIBRATION OF LARGE AREA SCINTILLATION COUNTERS ON COSMIC RAYS. Saterlie, S.F.; Tompkins, D.R. Jr. (Department of Physics and Astronomy, University of Wyoming, Laramie, Wyoming 82071). Rev. Sci. Instrum. 46: No. 7, 857-862 (July 1975).

We report on the construction and calibration of a 6 m^2 scintillation counter. The counter consisted of two $1.22\times2.44\times0.051$ m pieces of clear Lucite which were optically joined along a common edge. Optically coupled on top of these were sixteen $0.61\times0.61\times0.019$ m squares of NE 110 plastic scintillator. Light collection was achieved with eight photomultiplier tubes. This counter had an operational attenuation length of 4.8 ± 0.9 m. Calibration of this counter with an anticoincidence counter to discriminate against multiple particle events is described. This anticoincidence counter permitted particles that passed through a small calibration area to be counted only if no other particles were passing through the remainder of the detector at the same time. Large area counters will often receive more than a single particle per event. Theoretical calculations for purely electromagnetic extensive air showers indicate that the 6 m^2 counter tested receives an average of 2.5 particles per event. The calibration data yield 1.79 ± 0.08 particles per event. These results imply that if calibration on the response from a single particle of an extensive air shower is desired, it is necessary to use the anticoincidence counter method described for counters of more than a few square meters area. (auth)

14358 AN ANALYSIS OF THE ENERGY ERRORS IN THE CALIBRATION OF RADIOMETRIC INSTRUMENTS. Kholopov, G.K.; Shuba, Yu.A.; Yalyshev, F.Kh. Sov. J. Opt. Technol. 41: No. 8, 419-421 (Aug 1974).

The energy errors of radiometric instrument calibration are analyzed. The relative partial derivatives of the energy quantity, determining the output signal magnitude, with respect to several parameters

characterizing the instrument, calibration source, and calibration conditions are calculated. It is shown that the calibration sources now used with temperatures up to 300 °C are generally not the optimal from the viewpoint of calibration errors. (auth)

14359 EVAPORATIVE DEGRADATION OF HgI_2 X—RAY DETECTORS. Scott, R.S. (General Analytic Safety Systems Corporation, 195 Nassau Street, Princeton, New Jersey 08540); Fredericks, G.E. Appl. Phys. Lett. 27: No. 2, 99-100 (15 July 1975).

The instability of unprotected HgI_2 x-ray detectors in vacuum, contrasted with their apparent stability in air is examined. The degradation is treated as a result of noncongruent sublimation of Hg and I_2 from the detector surface, resulting in a buildup of free Hg atoms. The calculations indicate that the observed degradation of these devices in vacuum is to be expected, and that similar degradation in air will occur at rates 10^3–10^4 times more slowly. (auth)

Radiation Dosimeters

14360 (KFKI-75-10) BeO AS A THERMOLUMINESCENT DOSIMETER. Lakosi, L.; Szabo, P. P.; Makra, S. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Jan 1975. 16p. Dep. NTIS (US Sales Only) $4.00.

Investigations of the thermoluminescent characteristics of BeO ceramic discs are reported. Scatter in the sensitivity of individual discs was found to be as high as a factor of two, this drawback being overcome by selection. Thermal neutron sensitivity and sensitivity to sunlight were also investigated. An accuracy of 4 to 5% can be reached in dose determination in the range of 10 to 10^4 R; determinations down to 0.5 R and up to 10^5 R are obtainable but with a lower degree of accuracy. (auth)

14361 USE OF ^{237}Np IN PERSONAL DOSIMETERS FOR FAST NEUTRONS. Cross, W. G.; Ing, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys.; 28: No. 5, 511-520(May 1975).

As the radiator for a damage-track, fast neutron dosimeter, ^{237}Np has advantages over ^{232}Th, the most important being its lower energy threshold. It has not been used in personal dosimeters because of possible hazards from α contamination and γ dose to the wearer. This paper describes the manufacture and properties of two types of Np radiators (as an alloy with Al and a sintered mixture with Au) for which the removable surface activity is less than about 2 dis/min/cm^2 foil. Expressions are given for the neutron detection efficiency of detectors having radiators of pure or diluted fissionable material, with or without a protective coating. These show that adequate containment of the activity need not reduce the efficiency of a given amount of Np by more than 50%. A Np-alloy radiator (0.6 mg of Np) producing 270 tracks per rad of fission-spectrum neutrons gives a dose equivalent of 34 mrem in 2000 h at 5 cm. Circumstances in which thermal neutrons or high energy γ radiation may interfere with fast neutron measurements are discussed. (auth)

14362 USE OF A CALORIMETER FOR NEUTRON DOSIMETRY. Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.); Major, D.; Redpath, T. Phys. Med. Biol.; 20: No. 2, 244-254(Mar 1975).

The dose given to a polythene energy absorber in the radiation field from a 14-MeV neutron generator has been measured calorimetrically. The calorimeter was calibrated by giving the energy absorber a known dose of γ-rays. The dose measured in this way was compared with that determined with a polythene-ethylene ionization chamber, and the two results agreed to better than 1%, though the estimated uncertainties on the calorimeter and ionization chamber results were each about 4%. This result can be used to determine a value of the ratio W_n/W_e, for 14 MeV neutrons in ethylene, where W_n is the W value for the charged particles generated in the neutron field in ethylene, and W_e is the W value for electrons in the same gas. The measured value of W_n/W_e was found to be 1.7 ± 3.9%. The significance of the "thermal defect" in polythene is discussed. (auth)

14363 INVESTIGATION OF POSSIBLE ERROR SOURCES DURING DETERMINATION OF THE ABSORBED-DOSE RATE FROM FLAT BETA-SOURCES BY EXTRAPOLATION CHAMBERS. Vasil'ev, V. V.; Uryaev, I. A. Tr. Metrol. Inst. SSSR; No. 125, 129-134(1973). (In Russian).

It is recommended that with the use of electrodes in the form of rings with gaps of up to 0.5 mm, it is necessary to compute the effective area of the electrode (formula given). It is desirable to measure the distances between the electrodes in a vertical direction by a micrometric device with a scale value of 0.001 mm or by means of indirect measurements by the method of capacitance determination. For obtaining a more exact result, the contact measurements should be conducted at $d < 0.4$ mm. In designing the chambers, the potential electrode should be fastened in such a manner that there will be no auxiliary parts between the source and the chamber. (JPRS)

14364 APPLICATION OF THE PHOTOLUMINESCENT GLASS FOR THE RADIATION DOSE MEASUREMENT. Kodl, O.; Trousil, J. (Inst. of Hygiene and Epidemiology, Prague). pp 159-167 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The problems involved in measuring exposure and absorbed doses in a biological environment give the specific demands for the measuring method. In view of certain advantages of the photoluminescence method in these applications, such as low fading, wide range of measurable exposures, repeatability of response measurements, reusability and the small size of the detector coupled with relatively high sensitivity, we have developed a method for exposure measurement by means of the photoluminescent glass plates. The experimental work was performed with Jokota glass-plates Type FD-3, of the following composition: 44.34% $LiPO_3$, 50% Al/PO_3, and 5.66% $AgPO_3$ as an activator. The photoluminescent response was measured by means of a Toshiba FGD-6 apparatus. This paper presents some results of the measurement of the basic dosimetric characteristics. (auth)

14365 DRAFT OF AN ACCIDENTAL DOSIMETER OF FAST NEUTRONS. Nikodemova, D.; Hrabovcova, A.; Minarik, F. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 205-218 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

For the estimation of dose equivalent of fast neutrons in the case of an accident, a dosimeter consisting of threshold detectors is proposed, each detector covering, with regard to their threshold energy, an energy range up to 14.5 MeV. Information about the spectral distribution of the fast neutrons obtained from such a dosimeter will be used to compute the dose. For simplicity, three threshold detectors have been selected (sulfur, indium, aluminum) utilizing five threshold reactions. (ERB)

14366 TESTING AND CALIBRATION OF EMISSION DETECTORS ON AN ISOTOPIC GAMMA-INSTALLATION. Mukhachev, B. V.; Melissin, V. L. Yadern. Priborostr.; No. 24, 40-46(1974). (In Russian).

Results are presented of tests on vacuum emission detectors with emitters of tantalum, zirconium, and stainless steel in gamma-radiation fields of ^{60}Co within the exposure-dose rate range R_γ of 65 to 1200 R/sec. The collector material is stainless steel. The dimensions of the sensitive part are 6 × 150 mm. A procedure is described for calibration of the emission detectors in a radiation field of inhomogeneous length. The sensitivities of detectors with tantalum, zirconium, and stainless-steel emitters were measured, which turned out to be respectively equal (22, 6, and 1.4) × 10^{-13} A(R/sec). Test results confirmed the viability of emission detectors in the indicated range of R_γ, and showed that the exit points are directly proportional to the value of R_γ. It is recommended that emission detectors be used as detection units in systems of operational monitoring of the energy-release distribution in atomic power plant reactors. (JPRS)

14367 NEW METHOD FOR DETERMINING THE NEUTRON RESPONSE FUNCTION OF "NEUTRON INSENSITIVE" DOSIMETERS. Method and Preliminary Determinations. Kuchnir, F. T.; Vyborny, C. J.; Skaggs, L. S. (Univ. of Chicago Hospitals and Clinics). Radiology; 116: No. 1, 217-219(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(1 Dec 1974).

Charged-particle bombardment of thick beryllium targets produces a neutron yield varying with angle, and an isotropic gamma component. Differences in detector response in such a field are due to neutrons alone. With accurate neutron spectral distributions and measurements of detector response, a computer code can be used to determine the neutron sensitivity of the detector as a function of energy. (auth)

14368 LOW DOSE MEASUREMENTS BY FLUORESCENCE DECAY OF RADIOPHOTOLUMINESCENT GLASSES. Barthe, J.; Commanay, L.; Blanc, D. (Toulouse-3 Univ., 31 (France). Centre de Physique Atomique et Nucleaire); Chapuis, A.-M.; Francois, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). Radioprotection; 9: No. 3, 193-204(1974). (In French).

A new method for reading radiophotoluminescent glasses used in dosimetry is described. The glass sample is excited with very short light pulses. For a chosen time interval the decay time of the exponential component which fits the fluorescence decay is determined. The experimental relationship between time constant and absorbed dose in glass follows a simple formula proved for doses between 0.1 mrad and 50 rads. (FR)

14369 USE OF KODAK NTA PERSONNEL NEUTRON-MONITORING FILM AS TRACK-ETCHING DETECTOR. Jasiak, J.; Piesch, E. (Karlsruhe Nuclear Research Center, Health Physics Division, Karlsruhe, Federal Republic of Germany). Nucl. Instrum. Methods; 125: No. 4, 545-548(1 May 1975).

The cellulose-triacetate base of the Kodak NTA Personnel Neutron-Monitoring Film was applied as track-etching detector for the registration of neutron-induced recoil ions after a high neutron exposure. The technique for removing the emulsion and etching the film base, the background track density, the non-uniformity of the detector response, as well as the lower neutron detection limit were studied. The response to ^{252}Cf neutrons was found to be 0.37×10^{-5} tracks/neutron compared to 0.88×10^{-5} tracks/neutron for a Makrofol E recoil detector. The track-etching technique extends the dose range of the film emulsion from 0.9 rad up to 300 rad with an overall uncertainty of ±20%. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 15076.

14370 (CEA-NT-49) A PROGRAM FOR THE COMPUTER PROCESSING OF DIODE γ SPECTRA FOR USE WITH A MULTI/8 COMPUTER. Goujon de Beauvivier, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Feb 1975. 77p. (In French). INIS.

A fortran IV program for computer processing of diode γ spectra was translated into assembler and Multi-8 evoluted language (LEM) for use with an Intertechnique Multi-8 computer. (FR)

14371 (CONF-731166-, pp 13-23) LONG TERM VACUUM CYCLING ENSURES RELIABLE, NOISE-FREE OPERATION OF A SURFACE BARRIER DETECTOR IN SPACE ENVIRONMENT. Bawdekar, V. S. (American Science and Engineering, Inc., Cambridge, MA). 1973.

From 3rd symposium on reliability in electronics; Budapest, Hungary (13 Nov 1973).

In 3rd symposium on reliability in electronics. (Magyar Tudomanyos Akademia, Budapest).

This paper describes briefly the operation of a surface barrier detector, the effect of an increase in noise voltage on the resolution of a detector/preamplifier combination and the effect of changes of pressure and temperature on the noise voltage of a detector with surface contamination and is followed by the description of the long term vacuum cycling method developed to reduce its noise voltage. Finally, test results on detectors are presented to show that the long term vacuum cycling method reduced the noise voltages of detectors with contaminated surfaces and ensured their reliable and noise free operation in a space environment. (auth)

14372 (FRNC-TH-511) DEVELOPMENT OF A FAST "CONDITIONOR" FOR REDUCING NUCLEAR SPECTRA. Hoffmann, J. (Strasbourg-1 Univ., 67 (France)). 1972. vp. (In French). INIS.

To obtain multi-parameter nuclear spectra a large number of encoding channels is used in order to benefit from the very good resolution attained by Ge(Li) detectors. The spectra displays certain peaks separated by zones without interest. The addresses corresponding to the zones of interest are selected by means of a conditioner. This unit is a wired computer; the parameters given are the lower and upper threshold of each zone of interest and the incident addresses are sorted by comparison with each of these limits. The addresses chosen (binary digits) are transformed for optimum use of the memory. The sorting and transformation operations on the incident address are carried out mainly by combinative computing. The logic modules necessary (active memory, binary adder, and decimal-binary transcoder) are provided by integrated circuits of the TTL family. The functioning of the circuits is comprehensible by the truth table expressed in logic diagram and theoretical plan form. The conditioner, its adaptation to the coder and the display system for the zones of interest are described (the new address is obtained in 0.5 μs). This conditioner is used to measure mean lifetimes and angular correlations. (FR)

14373 (GSI-J-2-74, pp 13-18) DEVELOPMENT WORK ON THE SOLENOID-Si(Li)-β-SPECTROMETER. Backe, H.; Kankeleit, E.; Kuphal, E.; Richter, L.; Schroeder, W. U.; Willwater, R.; Martin, B.; Pelte, D. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

For the in-beam spectroscopy of conversion electrons after heavy ion reactions beneath an iron-free orange-type spectrometer, a solenoid-Si(Li)-spectrometer should be used at GSI. It consists of an energy analyzing Si(Li)-detector and of a solenoid-coil focusing emitted electrons from the target to the detector. Opposite to the Si(Li)-detector a Ge(Li)-diode is placed to measure the γ-spectra and electron-γ-coincidences. (auth)

14374 (GSI-J-2-74, pp 19-27) PLANNING AND PREPARATION OF TIME-OF-FLIGHT EXPERIMENTS AT GSI. Bass, R.; Czarnecki, J. V.; Giapoutzidis, V.; Hartmann, V.; Patscher, W.; Roemhild, K.; Zitzmann, R. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

For the experiments at GSI the preparations on the time-of-flight spectrometer and the detector systems to be used are reported. It deals with a time-of-flight spectrometer with magnetic focusing, an electrostatic focusing and detector developments such as local sensitive plastic scintillators and gallium-drifted ZnO-scintillators. (GE)

14375 (GSI-J-2-74, pp 28-32) HYBRID ENERGY ANALYSER. Groeneveld, K. O.; Kessel, W.; Koehler, E.; Spohr, R. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

An electron spectrometer for energy and angular distribution measurements of low energy electrons is described. The interesting energy region reaches from some eV to some keV at an energy resolution of about 1 eV. The hybrid analyzer consists of two separated electron optical units. Setting the voltage of the superpositioned deflecting unit depends on the elected energy resolution. (GE)

14376 (GSI-J-2-74, pp 33-38) DETECTOR SYSTEMS FOR THE INVESTIGATIONS OF HEAVY ION REACTIONS. Pfeffer, W.; Kohlmeyer, B.; Rode, I.; Puehlhofer, F. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Central points of the development work of our group in the year of report (July 73 up to June 74) was the further development of a time-of-flight spectrometer for heavy ions and investigations of the suitability of an ionization chamber as a detecting system for heavy ions. (auth)

14377 (GSI-J-2-74, pp 39-47) INVESTIGATION OF HEAVY ION INDUCED SECONDARY ELECTRON EMISSION AND FURTHER DEVELOPMENT OF A DETECTOR SYSTEM FOR HEAVY IONS. Clerc, H. G.; Jungmann, R.; Lang, W.; Lehmann-Carpzov, W.; Pferdekaemper, K. E.; Schmidt, K. H.; Wolfarth, H. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

First measurements of the energy spectra of secondary electrons (SE) in the energy region I eV up to 4 keV are reported for several ions. Measuring the dependence of the SE-yield on the foil thickness characteristic differences for several ions are apparent, which are interpreted together with the measured energy spectra. For multi-parameter measurements with detector-telescopes a module program system was developed and used for a measurement of the SE-signal of mass separated ^{252}Cf fission fragments. (GE)

14378 (GSI-J-2-74, pp 48-49) DETECTORS FOR THE IDENTIFICATION OF HEAVY IONS IN SCATTERING CHAMBERS. Mutterer, M.; Theobald, J. P. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Gas scintillation detectors as measuring instruments for heavy ions and spatial sensitive detectors, for delta-electrons of heavy ion reactions in thin foils are reported. (GE)

14379 (GSI-J-2-74, pp 50-53) SPATIAL SENSITIVE PROPORTIONAL COUNTER FOR MAGNETIC SPECTROGRAPH. Gruner, R.; Wilcke, W.; Elze, T. W. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

The spatial resolution and the efficiency of a proportional counter was measured. The spatial resolution was about 1 mm at a length of 40 cm of the counter tube and there was a good linearity over all channels of the spatial spectrum in an on-line computer. (GE)

14380 (NP-20343, pp 104-107) COMPUTER PROGRAM FOR THE ANALYSIS OF GAMMA SPECTRA. Binder, I. (Univ. of California, Berkeley); DiCasa, M.; Kratz, J. V.; Liljenzin, J. O.; Norris, A. E. 15 Jun 1974. (In German).

In annual report, 1973.

14381 FAST NEUTRON SPECTROMETER UTILIZING A SINGLE Si(Li) OR Ge(Li) SURFACE BARRIER DETECTOR. Chung, M. K.; Kang, H. D. J. Korean Phys. Soc.; 7: No. 1, 8-21(1974).

A telescope for the detection of neutrons in the energy range from a few MeV to about 20 MeV is described. The counter, designed to be operated at an external target geometry, utilizes either a single Si (Li) or Ge (Li) surface barrier detector and a combination of ring-shaped vertical and cone-shaped horizontal polyethylene proton converters. For proper choice of radiator thickness and radiator-detector geometry to provide high detection efficiency and little loss in energy resolution, the counter efficiencies and resolutions are calculated at various configurations of radiator-detector systems. By several modifications made on a telescope detector previously designed, the peak to background ratios were improved to 2 : 1 in the case of silicon and 6 : 1 in the case of germanium detectors. The relative response of germanium and silicon detectors to 14.1 MeV neutrons is compared by measuring the total number of interactions in each 1-MeV interval for the same integrated counts of recoil proton peaks obtained by each detector. (Korean Sci. Abstr.)

14382 POSITRON LIFETIME SPECTROMETER FOR METAL STUDIES. Myllylae, R.; Karras, M. (Oulu Univ. (Finland). Dept. of Electrical Engineering). Appl. Phys.; 4: No. 2, 157-159 (Jul 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

The instrument described is of the fast-slow coincidence type based on the well known time-to-amplitude conversion principle. Simplicity in circuit design has been achieved by using IC components. Special attention has been paid to the fast response and the pile-up limiter circuits. The temperature stability is adequate (5 psec/°C) for measurements made under normal laboratory conditions. Positron lifetimes were measured in both annealed and deformed copper. (auth)

14383 HIGH FIELD MOESSBAUER SPECTROSCOPY. Chappert, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). J. Phys. (Paris), Colloq.; No. 6, 71-88(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

External magnetic fields ranging from a few kOe 10 150 kOe are now commonly used in Moessbauer spectroscopy. The possibilities for solid state physics investigations which become possible when a coil producing a high external magnetic field is added to a conventional Moessbauer spectrometer are reviewed. Outlines of representative experiments as well as some recent technological developments of the high field Moessbauer spectrometry (HFMS) are discussed. (FR)

14384 AN ANALYSIS METHOD OF GAMMA-RAY PULSE-HEIGHT DISTRIBUTIONS OBTAINED WITH A Ge(Li) DETECTOR. Sasamoto, N.; Koyama, K.; Tanaka, S. I. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Nucl. Instrum. Methods; 125: No. 4, 507-523(1 May 1975).

A method is proposed for analysis of the gamma-ray pulse-height distribution (PHD) obtained with a Ge(Li) detector, which makes use of a fitting technique based on a nonlinear least-squares method. The successive steps of analysis are thus made from peak search to estimations of gamma-ray peak areas, peak locations, and their errors. Gamma-ray peaks and background continuum are expressed in a Gaussian distribution function; an exponential function is connected smoothly with the Gaussian at a certain point on the low-energy side of a gamma-ray peak, a newly defined Valley Count Function (VCF) expressing the flat-background continuum located between Compton edge and centroid of peak, and a quadratic polynomial expressing the ordinary background continuum. From the results of the analysis obtained with a computational code, it was found that, to obtain meaningful solutions in gamma-ray PHD analysis, the full width at half maximum (fwhm) must contain three or more channels, and the separation between the peaks should be larger than half the fwhm in the analysis of a composed PHD having two peaks. The validity of the method is shown by an analysis of the gamma-ray spectrum of Ta isotopes. (auth)

High Energy Physics Instrumentation

Refer also to abstract 15078.

14385 (LBL-3643) DRIFT CHAMBER APPLICATION IN HIGH ENERGY PHYSICS. Sadoulet, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1975. Contract W-7405-ENG-48. 5p. (CONF-741213-19). Dep. NTIS $4.00.

From nuclear science symposium; Washington, District of Columbia, USA (11 Dec 1974).

The use of drift chambers in the field of high energy physics, existing apparatus, plans and ... dreams are reviewed. Low cost large area drift chambers, use of pulse height information, and high spatial resolution applications are discussed. (auth)

14386 (ORNL-TM-4803) CALCULATED PERFORMANCE OF A MINERAL-OIL-IRON IONIZATION SPECTROMETER. Gabriel, T. A.; Amburgey, J. D.; Santoro, R. T. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 48p. Dep. NTIS $5.50.

The calculated performances of two slightly different mineral-oil-iron ionization spectrometer designs are presented and compared with experimental data. The particle types considered are electrons, protons, and pions with momenta ranging from 3 to 17.3 GeV/c. Many of the factors which contribute to the overall performance of such a spectrometer and which are often omitted in other calculations are included in these calculations. In general, the agreement between the calculated and the experimental results is good. (auth)

14387 (PITHA-74(1974)) IONIZATION MEASUREMENTS OF RELATIVISTIC PARTICLES IN A STREAMER CHAMBER. Eggert, K. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.). 11 Feb 1974. 88p. (In German). INIS.

Two streamer chambers of 100 cm length, 30 cm height and 18 cm depth were constructed. The rise-time of the 400 kV, 7 nsec half-width high-voltage pulse is 1 nsec. The 5 mm streamers are photographed by an electronic image-converter and the photos interpreted by coordinatographs and an on-line computer. The gap length- and the streamer density-method are discussed in detail. The minimal ionization for helium is 3.3 ± 0.1 cm^{-1}, for neon 10.7 ± 0.2 cm^{-1} and the Fermi plateau $45 \pm 5\%$ about the minimal ionization. The ionization variation of a 22 cm track is 13% for helium. (GE)

Radiometric Instruments

Refer also to abstracts 14644 and 15086.

14388 METHODS FOR DETERMINING THE UNKNOWN COMPOSITION OF GEOLOGICAL FORMATIONS SURROUNDING A DRILL HOLE. (to Texas Development Corp.). Netherlands Patent 7,304,789/A/. 6 Apr 1973. 26p. (In Dutch).

An iterative method for finding the least squares fit in analyzing gamma energy spectra is given. The method is worked out for gamma spectra emitted by the component geological materials surrounding a borehole. A number of errors due to the working conditions are eliminated. The unknown spectrum is compared with a "weighted mean" spectrum composed of several standard spectra from spectra library, in a computer. The unknown spectra are recorded as functions of the depth in the borehole. (NL)

14389 MATERIAL CONTENT OF BINARY PHYSICAL MIXTURES AS MEASURED WITH A DUAL-ENERGY BEAM OF gamma RAYS. Nofziger, D. L.; Swartzendruber, D. (Purdue Univ., West Lafayette, IN). J. Appl. Phys.; 45: No. 12, 5443-5449(Dec 1974).

The content of water and soil in physical intermixtures was measured simultaneously and nondestructively by the attenuation of a dual-energy beam of gamma rays. The beam, 1 mm by about 3 cm in cross section, was devised by placing a 280-mCi source of ^{137}Cs behind a 389-mCi source of ^{241}Am, with lead collimators suitably aligned in front of each source and the scintillation probe. The probe was connected in parallel to two-separate amplifier-

analyzer-scaler systems, one being set in the integral mode to receive all pulses greater than 550 keV (for ^{137}Cs, 662-keV peak), with the other being set in the differential mode to receive all pulses in a band 35 to 85 keV (for ^{241}Am, 60-keV peak). When related to the count intensity in the high-energy range, the count intensity e caused by ^{137}Cs in the low-energy band was empirically found to be independent of the material in the binary mixture (soil and/or water) placed in the beam for measurement. Also, e could be well expressed by a cubic polynomial that was then used along with a dead-time correction to determine the attenuated count intensity attributable to the ^{241}Am source alone. Calibration of the system was then possible. Over-all measuring accuracy was on the order of ± 0.01 cm^3/cm^3 in water content and ± 0.02 g/cm^3 in soil content (bulk density) for a counting period of 5 min; these changed to ± 0.04 cm^3/cm^3 or g/cm^3 for a counting period of 5 sec. (auth)

14390 RADIOACTIVITY AND ITS APPLICATION IN MEASUREMENT AND CONTROL TECHNIQUES. Roedder, P. (Technische Hochschule Aachen (F. R. Germany). Inst. fuer Regelungstechnik). Regelungstechn. Prax. Prozess-Rechentechn.; 16: No. 7, 176-181(Jul 1974). (In German).

After an introduction concerning the properties of different nuclear radiations, measuring methods are described and error sources and attainable accuracies are named. Practical examples show that in some cases only radioactive measuring methods allow a continuous measurement and sufficient control results. Because of the hazards to population, licensing procedures and a strict surveillance are necessary. (auth)

14391 VARIOUS TYPES OF DENSITY MEASUREMENTS USING PRACTICAL EXAMPLES. Morgenstern, R. Maschinenmarkt.; 80: No. 78, 1519-1522(1974). (In German).

Among others the principle of radiometric density measurement is presented. All application examples are concerned with this latter method: charging of an electrolysis plant control of the bauxite content in the caustic soda of aluminum production, lead content during pigment production, quantity and solid content during suction dredge operation, automatic packing of bulk materials such as washing media, and density of foamy liquids. (GE)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 15002.

14392 RADIATION DAMAGE EFFECTS OF ELECTRONIC COMPONENTS. Lambert, K. P.; van de Voorde, M. H. (European Organization for Nuclear Research, Geneva). Ingenieurs-blad.; 44: No. 6, 140-143(1975).

An introduction is given to the problem of radiation damage effects of electronic components. This is followed by a discussion of the most important parameter changes and available protecting techniques for both discrete components and integrated circuits. (auth)

14393 IRRADIATION EFFECT BY ^{60}Co TO CONDENSERS USED IN ELECTRONIC CIRCUIT. Chee, C. K.; Cho, S. W. J. Korean Inst. Elec. Eng.; 23: No. 3, 67-69(1974). (In Korean).

Variations in the electrical properties of irradiated condensers were investigated. The following results are reported: The capacitance in O. F paper condenser is exponentially increased as the gamma-radiation is increased, but in polyethylene, ceramic, chemical, neostyrene, mylar condenser it is decreased, and in case of more than 10^7 of irradiation it has a saturated state. The breakdown voltage and tan δ in condensers except the O.F paper condenser, are exponentially increased as the quantity of gamma irradiation is increased but in case of more than $10^7\gamma$ of irradiation it decreased. (auth)

14394 COMPARISON OF INTERFACE-STATE GENERATION BY 25-keV ELECTRON BEAM IRRADIATION IN *p*-type AND *n*-type MOS CAPACITORS. Ma, T.P.; Scoggan, G.; Leone, R. (IBM System Products Division, East Fishkill, Hopewell Junction, New York 12533). Appl. Phys. Lett. 27: No. 2, 61-63 (15 July 1975).

The interface state induced by 25-keV electron beam irradiation in MOS capacitors having *p*- and *n*-type substrates with several different doping concentrations have been studied. For radiation dosage on or above the order of 1×10^{-5} C/cm^2, all of the radiation-induced interface-state distributions tend to have a similar shape which is asymmetrical about the midgap, independent of the type and concentration of the silicon dopants, and independent of the initial interface-state distributions. The states in the upper half of the silicon band gap are acceptor type which peak around 0.2 eV from the midgap, whereas the states in the lower half of the band gap are donor type with a lower density. For radiation dosage below 1×10^{-7} C/cm^2 the postradiation interface states are proportional to their initial values. An explanation based on the broken bond model is presented to account for the observations. (auth)

Miscellaneous Instruments

Refer also to abstracts 15441 and 15773.

14395 (CEA-CONF-2940) A CHRONOMETER OPERATING IN THE NANOSECOND RANGE INTENDED FOR MEASURING FLUORESCENCE DECAYS. Breuze, G.; Pelras, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 19 Nov 1974. 31p. (In French). (CEA-SES-PUB-SAI-74-247). INIS.

From one-day meeting on nuclear detectors; Grenoble, France (17 Oct 1974).

The principle of the statistical single photoelectron method to measure the decay time of weak fluorescences lasting about a nanosecond is given. A fluochronometer built on this principle is described, with special emphasis on the exciting light source efficiency and the characteristics of the PM tube detecting the fluorescence. These parameters govern the overall time resolution of the apparatus which is about 500 ps. A number of results illustrate the current applications of the device presented, especially that relating to research on the lifetimes of certain photosynthetic systems versus temperature (from 276 deg K to 4 deg K). This study was carried out on collaboration by the Saclay Electronics Services and the Biology Department. (FF)

14396 (CEA-CONF-2941) VACUUM MICROBALANCE FOR THE FINE DETERMINATION OF SOLID-GAS REACTION KINETICS. Nierlich, J.; Paidassi, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee). 1974. 34p. (In French). INIS.

From 12th conference on vacuum microbalance techniques; Lyon, France (23 Sep 1974).

A vacuum microbalance, used chiefly to study the zirconium-oxygen reaction at low pressure ($pO_2 = 10^{-3}$ to $1 \times 5\ 10^{-3}$ torr) in the temperature range 450 to 850°C is described. This instrument is a model MTB 18-10 SETARAM microbalance of symmetrical design, sensitive to approximately 0.4 microgram with the following two principal modifications; replacement of the cover by a metal box thermostatically controlled at 45 ± 1°C; adaptation of a vacuum-tight rotating device allowing the sample to be moved up or down both under residual vacuum and in the reaction gas. The first improvement reduced the pressure in the silica reaction vessel to 5×10^{-7} torr, and the initial degassing flux of the balance to approximately 3×10^{-6} torr $1s^{-1}$, after 48 h pumping; the second reduced the pollution of the zirconium sample to a very low value during the rise to temperature. A calibration technique was developed to adjust the oxygen pressure which was stabilized at ± 5%. (FR)

14397 (EUR-5100(Rev.)) CAMAC: A MODULAR INSTRUMENTATION SYSTEM FOR DATA HANDLING. Specification of Amplitude Analogue Signals Within a 50 Ω System. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

The EURATOM Report EUR 4100 defines the essential features of the CAMAC system of instrumentation. This system is primarily for online use with digital controllers or computers. This document specifies single-ended unipolar and bipolar amplitude analogue signals which are recommended for CAMAC compatible units as used in a 50 ohm transmission system. It includes and extends the specifications of the previous version, EUR 5100 (1972), and has been worked out in close cooperation with the U.S.AEC NIM Committee Analog Signals Working Group. Except for page 1, this report is identical to U.S.AEC Report TID-26614. (auth)

14398 (GSI-J-2-74, pp 91-96) PRESENT STATUS OF THE He-JET TIME-OF-FLIGHT MASS SPECTROMETER. Fares, Y.; Fass, R.; Schart, D.; Wien, K.; Wollnik, H. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

One and a half years ago the construction of a time-of-flight mass spectrometer was begun at Giessen. The spectrometer is coupled with a He-jet-transport-system, which can be used for more general nuclear spectroscopy experiments. Some technical

data of the He-jet-measuring chamber are given in the first part. The second and third part deals with test experiments on the products of spontaneously fissioned ^{252}Cf and the α-active ^{228}Th. (auth)

14399 (GSI-J-2-74, pp 97-103) THE GSI MASS-SEPARATOR PROJECT AT MAINZ. Burkard, K. H.; Dumanski, W.; Kirchner, R.; Otto, H.; Roeckl, E.; Lauppe, W.; Peuser, P.; Seckert, U. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

The development of the mass-separator at Mainz is described since the end of the year 1973. The electrostatic beam optics were changed, and further work on the defecting magnet and the target position is described. (GE)

14400 (RDT-C-7-6T(2-75)) THERMOCOUPLE MATERIAL AND THERMOCOUPLE ASSEMBLY, CHROMEL-P VERSUS ALUMEL, STAINLESS STEEL SHEATHED, MAGNESIUM OXIDE INSULATED. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Feb 1975. 29p. RSO.

This standard covers requirements for the fabrication of 300 Series stainless steel sheathed, magnesium oxide (MgO) insulated, premium grade Chromel-P vs Alumel thermocouple material and thermocouple assemblies. A minimum number of mandatory tests are specified. Additional tests are described and may be required at the option of the purchaser depending on the service and quality level requirements of the intended application. (auth)

14401 (RDT-C-7-17T) PLATINUM RESISTANCE THERMOMETER. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Apr 1975. 24p. RSO.

This standard covers the design, fabrication, and quality assurance requirements for sheathed alumina-insulated platinum resistance thermometers for continuous measurement of temperatures in the range of 0^0C to 660^0C in applications requiring high accuracy. These thermometers are for installation in thermowells and are not intended to form part of a pressure retaining boundary or to be exposed directly to reactor coolants or other process fluids. (auth)

14402 CONSTRUCTION AND CALIBRATION OF A FAST SUPERCONDUCTING BOLOMETER. Gallinaro, G.; Varone, R. (Univ., Genoa). Cryogenics; 15: No. 5, 292-293(May 1975).

The construction and calibration of a fast superconducting bolometer is described. The sensitive element is a tin film evaporated on a thin Al_2O_3 substrate obtained by anodization of the aluminum block which acts as a thermostat. The bolometer mount, which is designed for loose thermal contact with a helium superfluid bath, is shown. Calibration procedures are given. Performance characteristics are compared with those of semiconducting bolometers. (UK)

14403 NEW FIELD ION EMITTER FOR FIELD ION SOURCES OF QUADRUPOLE MASS SPECTROMETERS. Beckey, H. D.; Gierlich, H. H.; Heinen, H. J.; Hilt, E. (Univ., Bonn). J. Phys., E (London); 8: No. 5, 355-356(May 1975).

A new type of field ion emitter especially designed to meet the requirements of field ion sources for quadrupole mass spectrometers is described. When compared to the wire emitters usually employed, a fivefold increase in sensitivity of the quadrupole mass spectrometer for the field ionization of gases is obtained. (auth)

14404 EFFECT OF HIGH MAGNETIC FIELDS ON METAL FOIL STRAIN GAUGES AT 4.2 K. Walstrom, P. L. (Oak Ridge National Lab., TN). Cryogenics; 15: No. 5, 270-272(May 1975).

The behavior of some metal foil strain gauges in magnetic fields up to 6 T at room temperature and at the boiling points of nitrogen and helium has been investigated. At room temperature the Constantan alloy gauges showed a significant magnetically induced negative zero shift. Although at room temperature and liquid nitrogen temperature the Karma-type alloy gauges tested showed no observable magnetoresistance, they all showed a significant positive magnetoresistance at liquid helium temperature. (auth)

14405 RADIOACTIVE DECAY RATE AS THE BASIS FOR AN ULTRAPRESSURE GAUGE. Wanagel, J.; Ruoff, A. L. (Cornell Univ., Ithaca, NY). J. Phys., E (London); 8: No. 5, 423(May 1975).

It is proposed that the lifetime of ^7Be (and possibly other isotopes) be used as the basis of a pressure gauge with the potential of measuring pressures to several megabars. From previously published results it would seem that $(1/\tau)\ (d\tau/dP) = -(2.2 \pm 0.1) \times 10^{-2}$ Mbar^{-1} could be used as the basis for an ultrapressure gauge using BeO. (UK)

14406 GAMMA RAY DENSITOMETER FOR THE INVESTIGATION OF PULMONARY FUNCTION. Evans, A. L. (Western Regional Hospital Board, Glasgow); Davison, M.; Kennedy, J.; Shimmins, J. G.; Sutherland, G. R. Phys. Med. Biol.; 20: No. 2, 261-267(Mar 1975).

The design, construction and performance of a gamma ray densitometer are described. The instrument, which is used in the investigation of regional pulmonary function, has both digital and analogue outputs. (auth)

14407 MEASUREMENT OF KILOVOLTAGE BY THE PENETRAMETER. Theoretical Aspects. Jackson, W. (Western Regional Hospital Board, Glasgow). Phys. Med. Biol.; 20: No. 2, 268-281(Mar 1975).

The penetrameter method makes use of the attenuation in copper of a heavily filtered x-ray beam to predict the generating kV_p. This is derived from the matching step or copper reference number (CRN) of a film density matching process in which a fast and slow screen combination is employed. In the present work, theoretical spectra resulting from chosen representative kV and mA wave-forms have been derived by computer analysis, assuming Kramers' expression for the bremsstrahlung emission from a thick target. The CRN appropriate to each spectrum has been found and its relation to kV_p recorded. The uncertainty in the use of the penetrameter was expressed in terms of the spread of the CRN as a function of kV_p and waveform. The computer predictions agreed well with experiment, provided a fall in the fast-slow screen ratio with energy was postulated–a fall verified by separate experimental work in screen ratios. Since Kramers' expression relates only to bremsstrahlung radiation, the theoretical analysis has been extended to include the effects of K characteristic and extrafocal radiation. An expression has also been derived for the sensitivity of the penetrameter. (auth)

14408 A DEVICE FOR DRIVING A MOVING BODY. Faudou, J. C.; Moll, E. (Institut Max von Laue–Paul Langevin, 38 – Grenoble (France)); Georges, J. L.; Rivallant, Rene (CEA, 75 – Paris (France)). (to CEA, 75 – Paris (France)). French Patent 2,214,355/D/. 11 Jan 1973. 12p. (In French).

Description is given of a device for driving a moving body, capable of operating automatically in a restricted space and of withstanding high temperatures. It comprises a reversible motor connected to a driving shaft to which is keyed a first gear and mounted in a frame which oscillates about said driving shaft. The invention can be applied in particular to installations for the continuous study, through mass spectrography of fission products in a nuclear reactor. (FR)

14409 DEUTERIUM-LOADED NIOBIUM SINGLE CRYSTALS: A NEW MATERIAL FOR THE MONOCHROMATISATION OF THERMAL NEUTRONS. Schneider, J. R. (Institut Max von Laue–Paul Langevin, 38–Grenoble (France)); Stump, N. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.). Nucl. Instrum. Methods; 125: No. 4, 605-608(1 May 1975).

Niobium-deuterium single crystals show high neutron reflectivity over an angular range from 30′ to 85′. The absorption is so low that practically no limitation exists on the effective thickness of the monochromator. Today the commercially available niobium crystals are rodlike with a diameter of $\frac{1}{2}$", so that one has to set up a composite monochromator system. There are no serious problems, due to the activation of traces of tantalum normally found in niobium. (auth)

14410 PULSER CORRECTION TECHNIQUES IN PRECISE HALF-LIFE MEASUREMENTS USING CONSTANT AND EXPONENTIALLY DECAYING RATE PULSERS. Azuelos, G.; Crawford, J. E.; Kitching, J. E.; Kuchela, K. S. (McGill Univ., Montreal, Quebec (Canada). Foster Radiation Lab.). Nucl. Instrum. Methods; 125: No. 4, 579-585(1 May 1975).

In an attempt to achieve a precision of 0.1% in half-life measurements rate-dependent effects and pulser techniques for dead-time correction are reexamined with reference to beta-detection systems. In addition to the constant pulser method an exponentially decaying rate pulser is introduced and its advantages discussed. A practical method of dead-time correction is examined and its accuracy of correction explored. (auth)

14411 A CAMAC BUFFERED READOUT MODULE FOR A MULTIPLEXED ADC. Van Dellen, K.; Sporrel, F.; Taff, L. M. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut). Nucl. Instrum. Methods; 125: No. 4, 525-530(1 May 1975).

A CAMAC module is described for fast computer readout of a multiplexed nuclear ADC. A buffer is implemented to allow

CAMAC-to-computer transfers to overlap in time with the following ADC conversion cycle. Measurements indicate the module has a negligible contribution to hardware dead times. Special attention has been given to software-simplifying functions, ease of operation, and detection of error conditions. (auth)

14412 ROUTING SYSTEM FOR MULTIPLEXED NUCLEAR ADC. Sporrel, F.; van Dellen, K.; Uytenbogaardt, W. J.; Taff, L. M. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut). Nucl. Instrum. Methods; 125: No. 4, 531-533(1 May 1975).

A NIM-standard module is described for supplying routing signals for a multiplexed nuclear ADC. Seven inputs are encoded to 3 bits which are sent to a readout device (e.g., a computer). Data integrity is insured by appropriate input gating. The readout architecture permits each individual input of a multiplexed ADX to have an associated router. (auth)

14413 ION-OPTICAL PROPERTIES OF SYSTEMS HAVING CIRCULAR SYMMETRY IN THE PLANE OF MOTION AND APPLICATION TO THE MULTIPASSAGE MAGNETIC MASS SPECTROMETER. de Celles, M.; Baril, M.; Bolduc, L. (Laval Univ., Quebec City (Canada). Dept. de Physique). Nucl. Instrum. Methods; 125: No. 4, 535-544(1 May 1975).

Ion-beam devices like the multipassage magnetic mass spectrometer (MMMS) exhibit circular symmetry in the plane of motion. This fact can be used to advantage in describing the in-plane optical properties to second order. It points to a reduced set of independent coefficients which permit to express the remaining ones simply, and display the relationships between the various aberrations. When applied to the MMMS, this framework yields its transfer matrix for any number n of passages in terms of its component mirror and prism matrix elements, without resorting to repetitive multiplications of extended matrices. Features of interest in the design of the apparatus are discussed. (auth)

14414 MICRO-CHANNEL PLATE AS A PARALLEL-BORE COLLIMATOR FOR SOFT X-RAY IMAGING. Lieber, A.; Benjamin, R.; Lyons, P.; Webb, C. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 125: No. 4, 553-556 (1 May 1975).

It is shown that a micro-channel plate may be used as a parallel-bore collimator for imaging the soft x-rays emitted in laser-target interactions. Using Fe K radiation, it is found experimentally that degradation of spatial resolution due to grazing-angle reflections is a negligible effect. A camera made of a commercially available micro-channel plate of 9 μm bore diameter can give spatial resolution better than 20 μm. (auth)

14415 ANALYSIS OF EDDY-CURRENT FLOWMETERS. Feng, C.C.; Deeds, W.E. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37916); Dodd, C.V. J. Appl. Phys. 46: No. 7, 2935-2940 (July 1975).

Coils can induce and detect eddy current in nearby conductors. If the conductor is moving, the eddy currents are carried along with it slightly, and properly designed coils can measure the velocity of the moving conductor with considerable accuracy. Calculations have been made for various axially symmetric arrangements of coils and conductors using a relaxation program for a computer. Experiments have also been made, using mercury as the flowing conductor, with three- and five-coil flowmeters, with good agreement between measured and computed values. For any given arrangement there is an optimum frequency of operation, and different frequencies can give information about the velocity distribution. (auth)

14416 TIME-OF-FLIGHT MEASUREMENTS OF LOW-ENERGY ELECTRON ENERGY DISTRIBUTIONS FROM ION–ATOM COLLISIONS. Toburen, L.H.; Wilson, W.E. (Battelle Northwest Laboratory, Richland, Washington 99352). Rev. Sci. Instrum. 46: No. 7, 851-854 (July 1975).

A time-of-flight technique for the measurement of the energy spectra of electrons ejected in ion–atom collisions is described. Ionization is produced by a pulsed beam of protons which are obtained by chopping the dc proton beam from a Van de Graaff accelerator with a 3.33 MHz high voltage oscillator. Electron energy and angular distributions are derived from time-of-flight spectra recorded for different emission angles. This system is capable of measurements for proton energies from 0.25 to 2.0 MeV, ejected electron energies from 0.3 eV to several hundred eV, and electron ejection angles from 30° to 150°. The advantages and limitations of this technique are illustrated. (auth)

14417 CONTAINED SEM FOR EXAMINING RADIOACTIVE MATERIALS. Makohon, P.A.; Sisson, R.D.; Sheehan, J.E. (Savannah River Laboratory, E. I. du Pont de Nemours and Co., Aiken, South Carolina 29801). Rev. Sci. Instrum. 46: No. 7, 889-892 (July 1975).

A contained scanning electron microscope (CSEM) was designed and constructed at the Savannah River Laboratory. The facility consists of two stainless-steel glove boxes with separate compartments for specimen mounting and coating, specimen decontamination, SEM column and sample chamber, and containment of the vacuum pumping systems. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 13827 and 13892.

14418 (BNL-50448) ACCELERATOR PRODUCED NUCLIDES FOR USE IN BIOLOGY AND MEDICINE. A Bibliography, 1939–1973. Christman, D. R.; Karlstrom, K. I.; Fowler, J.; Lambrecht, R.; Wolf, A. P. (comps.). (Brookhaven National Lab., Upton, N. Y. (USA)). Apr 1975. Contract AT(30-1)-16. 188p. Dep. NTIS $7.00.

A bibliography of more than 1300 references on accelerator-produced nuclides for use in biology and medicine is presented. The information is arranged by subject and by specific nuclide. An author index is included. Appendices are provided of medical uses of specific elements and of radioisotopes not included in the main bibliography. (LCL)

14419 (KFK-2004) FLOW MEASUREMENTS IN A TWO STAGE SEPARATION NOZZLE USING FREE MOLECULAR PRESSURE PROBES. Ehrfeld, W.; Schmid, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Dec 1974. 38p. (In German). INIS.

Diploma thesis by E. Schmidt.

Measurements of flow and demixing phenomena using free molecular pressure probes have been made in a separation nozzle system where the kinetic energy of the heavy fraction of a first nozzle is used to continue separation in a second nozzle connected directly to the first (double deflection system). Measurements carried out on He/SF_6-mixtures show that there is a much stronger separation of the mixture in the downstream nozzle under condition of increased inlet pressure or decrease in the cut of the first nozzle, since due to the higher gas flow friction effects are reduced and, hence, higher speed ratios can be attained. If the flow in the downstream nozzle is ducted on both sides by stationary walls, the flow resistance of the downstream nozzle causes a marked accumulation of flow in front of the skimmer of the first nozzle. However, if the second nozzle is designed as a convergent nozzle, i.e., without an inner nozzle duct, speed ratios higher by about 20% are found at the inlet of the second nozzle due to the lower flow resistance. The reduced effect upon the upstream nozzle and the improved suction condition in the convergent nozzle could become important, especially if the radius of curvature of the second nozzle is considerably decreased relative to that of the upstream nozzle. (auth)

14420 (KFK-2092) DEVELOPMENT AND TEST OF AN EQUIPMENT FOR OPTIMIZATION OF SEPARATION NOZZLE SYSTEMS FOR THE ENRICHMENT OF URANIUM 235. Bley, P.; Ehrfeld, W.; Jaeger, F. M.; Knapp, U. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Mar 1975. 41p. (In German). Dep. NTIS (US Sales Only) $5.25.

Thesis. Submitted by F. M. Jaeger to Univ., Karlsruhe, Ger.

The optimization of separation nozzle systems must be conducted on the basis of extensive separation experiments with UF_6, since the coupled flow and diffusion phenomena in the separation nozzle can be assessed theoretically only in a qualitative way. New equipment for separation experiments is described which allows a comprehensive test program to be run within a reasonable period of time. Compared to test assemblies used so far the new equipment offers the advantage that the cut of the separation nozzle is recorded continuously. By using nozzles with variable geometry the cut, which changes markedly in a fixed separation nozzle when the operating conditions are varied, can be adjusted to any given value. By that means experiments, in which the cut does not assume the value required by the cascade circuit, can be avoided and the number of optimization experiments can be reduced considerably. For uranium isotope analysis the separation equipment is connected to a mass spectrometer via an automatic sampling system. All the data produced by the equipment are evaluated in computer programs immediately after the experiment and analyzed in the light of economic aspects of industrial-scale separation nozzle plants. The results of this analysis are used to set the conditions for the further experiments in finding the optimum operating conditions of a separation nozzle system. (auth)

14421 (KFK-2138) EXPERIMENTAL INVESTIGATION OF URANIUM ISOTOPE SEPARATION IN A SEPARATION NOZZLE SYSTEM WITH OPPOSED GAS JETS. Ehrfeld, W.; Knapp, U. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Mar 1975. 46p. (In German). Dep. NTIS (US Sales Only) $4.50.

In the separation nozzle method for ^{235}U enrichment, isotope separation is brought about by the mass dependence of the centrifugal force in a fast curved flow of gaseous uranium hexafluoride. If the stream line curvature is generated by deflection of a gas jet at a fixed wall, a steep velocity gradient exists within the flow regions near the wall. This results in relatively high friction losses and adversely affects the centrifugal force determining the separation. The generation of curved flow lines and the simultaneous avoidance of a steep velocity gradient are principally possible by mutual deflection of gas jets. Separation experiments performed in a separation system in which two band-shaped jets are opposed to each other are described. When H_2/UF_6-mixtures are used as a process gas, it appears that higher elementary effects of isotope separation are achieved with mutual jet deflection within the range of low expansion ratios than with jet deflection at a fixed wall. A comparison of the economics makes evident that at the present state of development the separation element with a fixed deflection wall is still clearly superior to the opposed jet separation nozzle. However, an interesting result is the relatively low specific energy consumption, which is attained in the case of mutual jet deflection when pure UF_6 is used as a process gas. The appendix deals with supplementary investigations of the flow configurations existing in the separation nozzle with mutual jet deflection. Using H_2/UF_6-mixtures it was found that a flow field can exist in which the opposed gas jets slide off at each other forming a flat angle. In this case, only negligible separation occurs between the isotopes and the mixture components, respectively. (auth)

14422 GAS CENTRIFUGE IN THE ISOTOPIC ENRICHMENT OF URANIUM. II. Clement, J. M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 19: No. 94, 115-123 (1975). (In Spanish).

The distribution of densities and pressures in a gas submitted to centrifugation and the distribution of the abundance ratio in centrifugation of binary mixtures are studied. The general differential equation of centrifugation and the expression of the maximum separation capacity are obtained. (tr-auth)

14423 DEVICE AND PROCESS FOR THE SULFUR ISOTOPES CONTINUOUS SEPARATION AND ENRICHMENT. Dewitt, R.; Jepson, B. E.; Schwind, R. A. (to USAEC, Washington, D. C.). French Patent 2,213,090/A/. 10 Jan 1974. 14p. (In French).

A procedure is described for the continuous separation and enrichment of S isotopes using a reflux system in closed cycle. The SO_2 reacts with NaOH to form $NaHSO_3$. The heavy isotopes of S are preferentially attracted by $NaHSO_3$ and consequently react with H_2SO_4 to form $NaHSO_4$ and SO_2 which contains very high proportions of heavy isotopes of S. The SO_2 enriched in heavy isotopes is then separated and the $NaHSO_4$ is reacted with NaOH to form Na_2SO_4 which is then decomposed in an electrodialysis unit to form NaOH and H_2SO_4 which are used in the preceding reactions; the separation and enrichment are thus made without significant loss of the initial material. (tr-FR)

14424 ISOTOPIC ENRICHMENT OF SF_6 IN S^{34} BY MULTIPLE ABSORPTION OF CO_2 LASER RADIATION. Lyman, J.L.; Jensen, R.J.; Rink, J.; Robinson, C.P.; Rockwood, S.D. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Appl. Phys. Lett. 27: No. 2, 87-89 (15 July 1975).

An increase in the ratio of S^{34}/S^{32} of 3300% over its natural ratio has been obtained by irradiating SF_6 in the presence of H_2 with an intensely focused CO_2 laser. The quantities of material separated are on the order of 100 μg. (auth)

Isotopic Power Sources

Refer also to abstracts 14154 and 14155.

14425 (BNWL-1845-9) PACIFIC NORTHWEST LABORATORY QUARTERLY REPORT TO SPACE NUCLEAR SYSTEMS DIVISION FOR JANUARY–MARCH, 1975. Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1975. Contract AT(45-1)-1830. 41p. Dep. NTIS $4.00.

The evaluation of the short-term compatibility tests with radioactive strontium fluoride have been completed; and the results show that tungsten and TZM provide the greatest resistance to fluoride attack of all the materials tested. Of the seven superalloys tested, Haynes 25 was the most resistant to fluoride attack and Inconel 600 was next best. The nine containment materials evaluated in the short-term tests were ranked according to their

estimated ability to provide long-term containment of $^{90}SrF_2$ in heat source applications. Factors included in ranking the materials were: compatibility with $^{90}SrF_2$, high temperature mechanical properties, external corrosion resistance, fabricability, weldability, and availability. Added weight was given to $^{90}SrF_2$ compatibility in making the ranking. Of the nine materials tested, Haynes 25 was the first choice with TZM and Inconel 600 being the second and third choices. The dissolution rate of WESF grade $^{90}SrF_2$ in demineralized water and seawater was determined. The dissolution rates for the radioactive fluoride were 5 to 10 times greater than those for similar nonradioactive fluoride. The preliminary thermodynamic analysis of the WESF $^{90}SrF_2$-alloy systems evaluated in the short-term compatibility tests was completed. The analysis shows that the superalloys would be resistant to attack by the $^{90}SrF_2$ and the major impurities present in the WESF $^{90}SrF_2$. The results also show, however, that certain minor impurities in the WESF $^{90}SrF_2$ (i.e., Cu, Fe, Cd) could react with some components of the alloys. The startup of the long-term compatibility tests has been delayed until FY-1976. However, hardware, equipment, and materials needed for the tests are now being assembled. (auth)

14426 (CEA-N-1787) RESISTANCE TO BURSTING OF ST RADIOISOTOPIC SOURCES FOR HEART STIMULATORS. Quillico, J. J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Feb 1975. 40p. (In French). INIS.

The decay of ^{238}Pu used as fuel element for ST radioisotopic sources causes helium to be released inside the free volume of the source. The pressure of this gas will increase with time and could lead to cracking and bursting of the source if brought to a high temperature. The maximum lifetime of the STO_1 sources (with triple-clad oxide fuel) manufactured at present, under normal (20°C) or accidental (incineration at 1300°C) conditions of use is estimated. Taking 12 years as the useful lifetime of the apparatus, results of theoretical and empirical calculations to determine the bursting pressure limits show that the calculated lifetime is definite at 20°C and 300 years at 1300°C. STO_1 sources thus offer a high degree of safety. (FR)

14427 (DPST-75-128-5) ^{238}Pu FUEL FORM PROCESSES. Savannah River Laboratory Monthly Report. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). May 1975. Contract AT(07-2)-1. 28p. Dep. NTIS $4.50.

Laboratory-scale precipitations of ^{239}Pu oxalate indicate that increasing the precipitation temperature increases particle size and reduces the agglomeration of particles. Increasing the nitric acid concentration in the ^{239}Pu feed stream to the precipitator also reduces particle agglomeration. The particle size of new production batches of ^{238}Pu appears to be decreasing. The pour and tap densities of milled ^{238}Pu from new production batches are between those for the old and the highly sinterable PuO_2. These observations are supported by the hot pressing behavior observed both at LASL and at SRL. Oxygen-16 exchange studies with oxalate-based ^{238}Pu have begun. Specific surface area was found to correlate with $^{239}PuO_2$ particle size after calcining at 1100°C. Specific surface area measurements of CeO_2 indicate that mercury porosimetry would not be sufficiently sensitive to determine the specific surface area of $^{238}PuO_2$. A vacuum hot press has been ordered for the PEF which is similar to the PuFF hot press. A delivery date of March 1976 is promised. (auth)

14428 (TID/SNG-1) STUDY OF SEPARATELY LAUNCHED MULTIUSE SPACE ELECTRICAL POWER SYSTEM. Midterm Technical Briefing. (General Electric Co., Philadelphia, Pa. (USA). Missile and Space Div.). 11 Jan 1968. 175p. Dep. NTIS $11.75.

The Separately Launched Power Module Program was initiated in Aug. 1967 to determine the technical feasibility of a separately launched radioisotope-fueled power module capable of docking with manned spacecraft and to provide technical data which might be used to evaluate the advantages and disadvantages of such a system. Progress to Jan. 1968 is reported. (LCL)

Radiation Sources

14429 APPARATUS FOR DETECTING SMOKE AND LIKE SUSPENSIONS. Varney, P. H. (to Graviner (Colnbrook) Ltd.). British Patent 1,381,475/B/. 22 Jan 1975. Filed date 16 Oct 1970. 15p.

Reference is made to apparatus for detecting smoke and other suspensions by virtue of the effect the suspensions produce on an atmospheric ionization current. The apparatus described comprises a detecting chamber arranged to allow ingress of the air in which smoke is to be detected; a source of ionization located in the chamber, together with an electrode system for establishing an electric field within the chamber, and sensing means operative to produce an output dependent on the smoke density in the chamber. The dimensions, ionization source and field strength are arranged so that the changeover from the quadratic to the linear portion of the current-voltage characteristic of the chamber occurs at an atmospheric pressure in the range of 320 to 100 torr. The apparatus is particularly suitable for detecting smoke in aircraft and other environments in which variations in ambient atmospheric pressure can be expected. (UK)

14430 A COMPUTER CONTROLLED NEUTRON GENERATOR FOR USE IN NON-DESTRUCTIVE DETERMINATION OF FISSILE MATERIAL IN REACTOR FUEL-ELEMENTS. Zeller, M. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Kerntechnik). Atomkernenergie; 25: No. 1, 57-64(1975). (In German).

A computer controlled pulsed neutron generator is presented for the nondestructive determination of the fissile material of highly enriched fuel elements using the delayed neutron technique. The computer controlled operation of the neutron generator is discussed in detail. The desired deuteron beam is adjusted in beam-off operation by means of a special generator model. This model is based upon the measured characteristics of the neutron generator. In the high voltage terminal an analog to digital device is installed for the measurement of the characteristics and for the adjustment of the computed desired values. The maximum deviation from the desired value of the deuteron beam adjusted by this model is ± 0.1 mA. (auth)

Design and Fabrication

14431 A METHOD FOR MANUFACTURING RADIOACTIVE SOURCES OF CERAMICS. Gauthe, Philippe; Langlet, Gerard. (to CEA, 75 – Paris (France)). French Patent 2,211,724/A/. 22 Dec 1972. 11p. (In French).

The invention relates to a method for manufacturing sources of ceramics with radioactive radiation. The method comprises the steps of preparing a support of selected shape from a compound having the general formula $(AO_4)_2 M_2^{\prime}$, putting that support in contact with a solution of a compound having the formula MX_2, containing radioactive ions, drying the thus-impregnated support, then thermally treating same. These sources can be used in all instances of application of beta-sources of similar activities, e.g., as thickness-gages or medical sources. (FR)

Industrial Uses

14432 (AED-CONF-75-061-007) DISINFECTION OF SEWAGE AND WASTE WATER BY IRRADIATION WITH ELECTRONS OF LOW ACCELERATING VOLTAGE. Holl, P.; Schneider, H. (Kleinewefers Industrie-Companie G.m.b.H. und Co. K. G., Krefeld (F. R. Germany)). 1975. 20p. INIS.

From international symposium on the use of high-level radiation in waste treatment: status and prospects; Munich, Germany (17 Mar 1975).

With abstract. Available from ZAED.

Complex experiments using accelerators with an accelerating voltage of about 400 kV have shown that it is not necessary to adapt the thickness of sewage sludge or water layer to the range of electrons. The layer to be irradiated may be much thicker if the substrate is revolved during irradiation. The advantages of this method are: (1) low accelerating voltage for the electrons and hence less costly radiation shielding; (2) complete absorption of the radiated energy by the substrate; (3) low investment and operating cost. The sterilizing effect of the process can be explained by the secondary reactions which take place in the water, in addition to the primary reactions, when irradiating with high specific ionizing density. It is known from experiments carried out by Ruth Muenzner that water irradiated with electrons of high specific ionization density when added to bacterial cultures will destroy these. This is explained by the radical theory of water by Weiss, with reaction products like H_2, O_2 and H_2O_2. The success of this process is shown by experiments with Escherichia coli; with tap water to which salmonella senftenberg were added deliberately; by the content of enterobacteriaceen in various sludges as a function of the irradiation period, as well as by the rate at which various invariable species of strongilide larvae, eggs of ascaris suum, fasciola hepatica and oocysts of eimeria spec. of poultry die down. Details are given also about the improved sedimentation behavior of the sludges. (auth)

14433 (AED-CONF-75-061-022) ALTERNATIVE HIGH LEVEL RADIATION SOURCES FOR SEWAGE AND WASTE-WATER TREATMENT. Ballantine, D. S. (Energy Research and Develop-

ment Administration, Washington, D. C. (USA)). 1975. 21p. INIS.

From international symposium on the use of high level radiation in waste treatment: status and prospects; Munich, Germany (17 Mar 1975).

Available from ZAED.

The choice of an energy source for the radiation treatment of waste-water or sludge is between an electron accelerator or a γ-source of ^{60}Co or ^{137}Cs. A number of factors will affect the ultimate choice and the potential future adoption of radiation as a treatment technique. The present and future availability of radioactive sources of cobalt and cesium is closely linked to the rate of nuclear power development and the assumption by uranium fuel reprocessors of a role as radioactive cesium suppliers. Accelerators are industrial machines which could be readily produced to meet any conceivable market demand. For energy sources in the 20 to 30 kW, electron accelerators appear to have an initial capital cost advantage of about seven and an operating cost advantage of two. While radioisotope sources are inherently more reliable, accelerators at voltages to 3 MeV have achieved a reliability level adequate to meet the demands of essentially continuous operations with moderate maintenance requirements. The application of either energy source to waste-water treatment will be significantly influenced by considerations of the relative penetration capability, energy density, and physical geometrical constraints of each option. The greater range of the γ-rays and the lower energy density of the isotopic sources permit irradiation of a variety of target geometrics. The low penetration of electrons and the high energy density of accelerators limit application of the latter to targets presented as thin films of several centimeters thickness. (auth)

14434 (AED-CONF-75-061-023) THE USE OF HIGH-POWER ELECTRON BEAM RADIATION FOR THE TREATMENT OF MUNICIPAL AND INDUSTRIAL WASTES. Cleland, M. R.; Farrell, J. P.; Malnati, R. L.; Morganstern, K. H. (Radiation Dynamics, Inc., Westbury, N. Y. (USA)). 1975. 14p. INIS.

From international symposium on the use of high-level radiation in waste treatment: status and prospects; Munich, Germany (17 Mar 1975).

With abstract. Available from ZAED.

One of the factors impeding the use of ionizing radiation for waste treatment has been the relatively high cost of large radiation sources. This obstacle has been reduced by the recent development of powerful electron beam accelerators which are now being used by many manufacturers to crosslink plastic and rubber compounds and to sterilize ethical products. The industrial demand for radiation processing equipment has produced a new technology which can be applied to the irradiation of waste materials. Electron accelerators can now provide 150 kilowatts of useful beam power for continuous service. Such machines could process 3.1 MGD (million US gallons per day) of water to an average dose of 0.1 Mrad. The unit cost for the radiation process would be about 0.22 per 1,000 gallons. Larger systems delivering up to a megawatt of power could be developed within a few years if needed for large scale applications. Such equipment would bring the radiation processing cost down still further and would increase the capacity to about 22 MGD. This throughput would be comparable to the waste water effluent of large sewage treatment plants in the New York City area. High-power electron beams may be particularly useful in the treatment of gaseous wastes. The irradiation of stack gases from large electric power stations, a process which is now being investigated in Japan, is a possible application that could justify the development of multi-megawatt electron beam systems. (auth)

14435 (AED-CONF-75-061-029) CONSIDERATIONS IN THE PUBLIC ACCEPTANCE OF SEWAGE SLUDGE IRRADIATION SYSTEMS. Dix, G. P. (USAEC, Washington, D. C.). 1975. 13p. INIS.

From international symposium on the use of high-level radiation in waste treatment: status and prospects; Munich, Germany (17 Mar 1975).

With abstract. Available from ZAED.

Plant safeguards must be explained to dispel public concern that the contents of the source can be released to the sludge accidentally. This will be the main issue within the technical sector of the public. The design, procedural, and administrative safeguards of the plant must be fully conveyed. The primary risk associated with sludge irradiators will be the remote possibility of source leakage into the sludge. The various safeguards in sludge irradiation plants are discussed in detail including the form of the radionuclide, encapsulation, irradiation chamber, safeguards instrumentation, shielding, and thermal safeguards. (auth)

14436 X-RAY SOURCE FOR MAMMOGRAPHY. Joetten, G. (Mueller, (CHF) Gmbh, Hamburg); Kyser, K.; Oosterkamp, W. J. Medicamundi; 19: No. 1, 25-27(1974).

The question whether the use of an x-ray tube with a molybdenum target combined with a molybdenum filter is always optimal for mammography, in particular with respect to heavy mammae, was investigated. Calculations and measurements of contrast and dose are made for different combinations of target and filter materials. The results are compared with those of clinical experience. (NL)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 14479, 14488, 14554, 14567, and 14572.

14437 (MBL-1974-12) CONTRIBUTION OF VARIOUS TYPES OF DAMAGE TO INACTIVATION OF BACTERIOPHAGE PM2 DNA IN FROZEN SOLUTION BY GAMMA IRRADIATION. van der Schans, G. P.; Bleichrodt, J. F. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 14p.

When biologically active double-stranded circular DNA of the bacteriophage PM2 in a solution of nutrient broth is irradiated at −195°C by ^{60}Co gamma rays, about 85% of the inactivation is due to damage in the nucleotides not associated with chain break. Double-strand breaks contribute for some 10 percent to lethality and single-strand breaks only for a minor fraction, if at all. About 10 percent of the nucleotide damage which is lethal if present in single-stranded DNA is lethal in the double-stranded PM2 DNA. These results do not show large differences with those obtained previously for irradiation of PM2 DNA under conditions of indirect effect. (NL)

14438 (MBL-1974-29) RADIOSENSITIZATION OF BIOLOGICALLY ACTIVE DNA IN CELLULAR EXTRACTS BY OXYGEN. van Hemmen, J. J.; Mueling, W. J. A.; Bleichrodt, J. F. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 21p.

The radiosensitization by oxygen of biologically active bacteriophage DNA in bacterial extracts was studied. The oxygen-effect in such a system appeared not to be due or only to a minor extent to the presence of endogenous sulfhydryl compounds. The components in a cell extract that enable oxygen and other sensitizers to sensitize DNA could not be destroyed by extremely high doses of γ irradiation. (NL)

14439 INHIBITION BY X IRRADIATION AND ANTIMETABOLITES OF DNA SYNTHESIS WITHOUT AFFECTING cAMP ELEVATION IN ISOPROTERENOL-STIMULATED MOUSE PAROTID GLAND. Furuno, I.; Asami, K.; Matsudaira, H. (National Inst. of Radiological Sciences, Anagawa, Japan). Exp. Cell Res.; 89: No. 1, 47-54(Nov 1974).

The concentration of adenosine 3',5'-cyclic monophosphate (cAMP) was measured in the parotid gland of the mouse after intraperitoneal injection of a beta-adrenergic drug, isoproterenol. A marked elevation of cAMP was observed 10 min after the administration, followed by a return to the control level within 40 min. A small peak was found around 14 h, onset of the stimulated DNA synthesis being observed at 20 h. A close relationship was found between the cAMP level at 10 min and the rate of DNA synthesis at 24 h in animals given different doses of the drug. However, DNA synthesis could not be induced by adrenalin in spite of a significant increase in the cAMP concentration. Furthermore, x irradiation or certain metabolic inhibitors (actinomycin D and cycloheximide), administered prior to isoproterenol, completely inhibited the stimulated DNA synthesis without affecting the cAMP elevation at 10 min. It is concluded that the critical step in the initiation of stimulated DNA synthesis may be located at a period later than the initial cAMP elevation. (auth)

14440 CIRCULAR DICHROISM STUDY OF THE CONFORMATION OF ULTRAVIOLET-INDUCED RIBONUCLEASE A. Schultz, R. M.; Iammartino, A. J.; Aktipis, S. (Loyola Univ., Maywood, IL). Biochim. Biophys. Acta; 386: No. 1, 120-128(28 Mar 1975).

Ribonuclease (RNAase) A irradiated by ultraviolet light at 254 nm shows a linear dependence between loss of activity and destruction of cystine. At least one of the cystine modified forms in irradiated RNAase is catalytically active. Circular dichroism spectra of irradiated RNAase show a marked decrease in ellipticity between 210 nm and 320 nm, an increased ellipticity between 230 nm and 240 nm, and a blue shift of the 210-nm minimum toward 205 nm. These circular dichroism changes indicate a partial disorganization of the native secondary and tertiary changes with irradiation. The temperature dependence of the circular dichroism shows the irradiated enzyme to be conformationally less stable to thermal perturbation than native RNAase. Differences in the polypeptide conformations of unirradiated RNAase denatured by heat and sodium dodecylsulfate, and irradiated RNAase treated with heat and sodium dodecylsulfate are discussed. (NL)

14441 DEPRESSION BY NAD OF X-RAY-INDUCED REPAIR-TYPE DNA SYNTHESIS IN TOLUENE-TREATED BACILLUS SUBTILIS. Billen, D.; Hellerman, G. (Univ. of Tennessee, Oak Ridge). Biochim. Biophys. Acta; 303: No. 4, 379-387(2 Apr 1975).

Nicotinamide adenine dinucleotide (NAD) prevents a DNA repair-type synthesis that is dependent on polymerase I in toluene-treated, x-irradiated Bacillus subtilis. In unirradiated preparations, NAD had little effect on an ATP-dependent, semiconservative synthesis but partially inhibited a repair-type synthesis. In a mutant lacking polymerase I (polA1$^-$), the presence of NAD did not affect dTTP utilization in DNA synthesis. Nicotinamide mononucleotide (NMN) partially reverses the NAD inhibition of repair-type DNA synthesis. NADP and FAD were ineffective as substitutes for NAD. Since NAD is the cofactor for polynucleotide ligase in Bacillus subtilis and NMN is known to discharge AMP from the active AMP ligase complex, it is proposed that activation of DNA ligase reduces dTMP incorporation by reducing sites for, or limiting DNA polymerase I action. (NL)

14442 ULTRAVIOLET REACTIVATION AND ULTRAVIOLET MUTAGENESIS OF INFECTIOUS LAMBDA DNA: STRONG INHIBITION BY TREATMENT OF DNA IN VITRO WITH uv-ENDONUCLEASE FROM MICROCOCCUS LUTEUS. Tomilin, N. V.; Mosevitskaya, T. V. (Inst. of Cytology, Leningrad). Mutat. Res.; 27: No. 2, 147-156(Feb 1975).

UV-endonuclease from Micrococcus luteus induced single-strand breaks in uv-irradiated DNA of phage lambda and the average length of the fragments produced was equal to the average spacing between pyrimidine dimers. The plaque-forming ability of uv-irradiated lambda DNA used to infect mutant cells of Escherichia coli may be significantly enhanced by treatment of lambda DNA with uv-endonuclease. This enzyme strongly decreases the reactivation of uv-irradiated lambda DNA, and eliminates most clear mutations. It was concluded that uv-endonuclease switches a significant part of potentially mutagenic pyrimidine dimers from the uv-induced "error-prone" repair pathway to "error-free" excision repair pathway. (NL)

14443 STRAND SEPARATION OF DNA INDUCED BY ULTRAVIOLET IRRADIATION IN VITRO. Das Gupta, R. (Bose Research Inst., Calcutta). Mitra, S. Biochim. Biophys. Acta; 374: No. 2, 145-158(6 Dec 1974).

Ultraviolet irradiation of double-stranded DNA in vitro causes strand separation, as judged by the susceptibility of the DNA to degradation by an endonuclease from Neurospora crassa. The extent of denaturation in DNA after ultraviolet irradiation was estimated, using the single strand-specific nucleases N. crassa endonuclease and E. coli exonuclease. Efforts were made to correlate the partial denaturation of DNA after ultraviolet irradiation with its elution behavior from hydroxylapatite and its sedimentation properties. (NL)

14444 THYMINE DIMER EXCISION AND DNA DEGRADATION AFTER THYMINE STARVATION AND ULTRAVIOLET IRRADIATION IN ESCHERICHIA COLI B/r Hcr$^+$. Balgavy, P.; Masek, F.; Turek, R. (Slovak Academy of Sciences, Bratislava). Biochim. Biophys. Acta; 390: No. 1, 24-27(16 Apr 1975).

Thymine starvation of exponentially growing Escherichia coli B/r Hcr$^+$ thy$^-$ trp$^-$ cells results in increased sensitivity to ultraviolet irradiation and in increased ultraviolet-induced DNA degradation. Excision of thymine dimers is not affected by a short-time (40 min), pre-irradiation starvation but it is inhibited after prolonged (105 min) starvation, when less than 1% of the population survives the starvation conditions. (auth)

14445 EFFECT OF RADIOSENSITIZING AGENTS ON DNA SINGLE-STRAND BREAKS AND THEIR REPAIR IN ANCYSTIS NIDULANS. Dmitriev, A. P.; Grodzinskyii, D. M. (Ukrainian Academy of Science, Kiev). Plant Sci. Lett.; 42: No. 2, 77-83 (Feb 1975).

The effects of the radiosensitizing agents iodoacetic acid and p-chloromercuribenzoate on the production and repair of DNA single-strand breaks induced in unicellular blue-green alga Anacystis nidulans by ionizing radiation were studied. The number of single-strand breaks in DNA, as measured by the alkaline sucrose gradient technique, was increased by these enzyme inactivating agents. The cells are apparently capable of rejoining by themselves breaks attributable to free radical attack as well as some produced by the direct action of radiation. The presence of radiosensitizing compounds during irradiation inhibited subsequent repair of single-strand breaks in the DNA of A. nidulans. It is concluded that radiosensitizing agents affect DNA repair in A. nidulans. (NL)

14446 PURIFICATION AND CHARACTERIZATION OF AN ENDONUCLEASE FROM CALF THYMUS ACTING ON IRRADI-

ATED DNA DOUBLE-STRANDED DNA. Bacchetti, S.; Benne, R. (Rijksverdedigingsorganisatie TNO, Rijswijk, Netherlands). Biochim. Biophys. Acta; 390: No. 3, 285-297(May 1975).

An endonuclease acting on DNA exposed to ultraviolet light or γ rays has been extensively purified from calf thymus. The enzyme has a pH optimum at pH 7.0 to 7.5, acts with equal efficiency in the presence of EDTA or divalent cations (Mg^{2+} or Ca^{2+}), is inhibited by NaCl and tRNA, and is inactivated by incubation at 50°C. Its molecular weight, determined by Sephadex chromatography or sodium dodecylsulfate gel electrophoresis, is approximately 30,000. The enzyme catalyzes the formation of breaks with 5'-phosphate termini in double-stranded DNA irradiated with ultraviolet or γ rays. It does not act on unirradiated DNA or denatured DNA. Since in all these properties the enzymatic activity on ultraviolet- and γ-irradiated DNA behaved similarly and since the two activities cochromatographed in all systems used during purification, we conclude that they are associated with the same protein. The site of action of the enzyme in ultraviolet-irradiated DNA is a photoproduct other than pyrimidine dimers. Such a photoproduct can also be induced by irradiation of the DNA in vivo, i.e., within the cells. (NL)

14447 UV-SENSITIVITY AND UV-MUTABILITY OF INFECTIOUS LAMBDA DNA. Reactivation, Protection and Mutability in Various Assay Systems. Wackernagel, W. (Bochum Univ. (F. R. Germany). Lehrstuhl fuer Biologie der Mikroorganismen). Mol. Gen. Genet.; 135: No. 1, 61-71(Dec 1974).

The uv-sensitivity of phage lambda and its infectious DNA have been compared in experiments involving infection of normal cells by phage and transfection of lysozyme-EDTA spheroplasts or Ca^{++}-treated cells by phage DNA. It is shown that uv-irradiated lambda DNA undergoes extensive host-cell reactivation (HCR). Since intact phage and free phage DNA have the same survival after uv irradiation in Hcr^- spheroplasts and cells, respectively, and since survival is also identical in Ca^{++}-treated Hcr^+ cells it is concluded that DNA in solution or packaged in the phage head provides the same target for the induction of lethal uv lesions. This conclusion is supported by the observation that cysteamine provides a similar radioprotection to the intact phage and its free DNA. Spheroplasts of Hcr^+ cells, however, have an HCR capacity reduced by about 20% when compared with normal or Ca^{++}-treated cells. Moreover, uv-reactivation of irradiated lambda DNA, which is absent in spheroplasts, occurs efficiently in Ca^{++}-treated cells. Possible reasons for the physiological difference between spheroplasts and normal cells are discussed. c-mutations, which are readily induced by uv in phage lambda assayed with E. coli mul^-, could not be induced in lambda DNA when assayed with spheroplasts or Ca^{++}-treated cells of this strain. No mutants were also found with DNA extracted from uv-irradiated phage. The significance of the mode of entry of uv-irradiated DNA into a cell for the production of mutations is discussed. (auth)

14448 DETECTION BY ELECTRON MICROSCOPY OF PHOTO-INDUCED DENATURATION IN LAMBDA DNA. Stafford, R. S.; Allison, D. P.; Rahn, R. O. (Oak Ridge National Lab., TN). Nucleic Acids Res.; 2: No. 2, 143-146(Feb 1975).

We have used an electron microscope to study localized denatured regions in ultraviolet-irradiated DNA. The DNA from bacteriophage λ was uv-irradiated and then prepared for electron microscopy after fixing in buffered (pH 9.5) formaldehyde solutions at 25°C. The denatured regions observed corresponded to those described by Inman and Schnös who used alkaline denaturation to preferentially destroy thymine-adenine base pairing. In uv-irradiated DNA, pairs of neighboring thymine residues are converted into photodimers; hence, loss of hydrogen bonding most likely occurs in thymine-rich regions and denaturation results. Conceivably, photo-induced denaturation may under some circumstances represent a more convenient method than alkaline denaturation for mapping thymine-rich regions in DNA. (auth)

14449 EVIDENCE AGAINST CLUSTERING OF THYMINE DIMERS IN ULTRAVIOLET-IRRADIATED DNA. Jonker, L. S.; Blok, J. (Vrije Univ., Amsterdam). Nature (London) Phys. Sci.; 255: No. 5505, 245-247(15 May 1975).

Some studies are described on the irradiation of DNA from bacteriophage T2 with 255 nm UV light. The main effect of such irradiation on DNA is the formation of pyrimidine dimers and for this form of DNA the only pyrimidine dimers produced are thymine dimers. The studies indicated that the hypothesis of clustering of thymine dimers through long range energy migration is unlikely to be correct. Reference is made to the work of Shafranovskaya (Nature New Biology 241 : 58 (1973)) leading to this hypothesis; the present authors repeated this work and obtained contradictory results. (UK)

Radiation Effects on Cells

14450 (COO-2382-9) MECHANISMS OF ABERRATION PRODUCTION IN EUKARYOTE CHROMOSOMES. Final Report, July 1, 1973—June 30, 1975. Bender, M. A. (Johns Hopkins Univ., Baltimore, Md. (USA). School of Medicine). 1975. Contract E(11-1)-2382 24p. Dep. NTIS $4.25.

Hardware for a semi-automatic chromosome analysis device was constructed and tested, and software written for its application to chromosome measurement and karyotype analysis. A comprehensive theory of eukaryote chromosomal aberration production by ionizing and non-ionizing radiation and by chemical agents was developed. Experiments were carried out to determine the patterns of aberration production by several specific agents, including 8-methoxypsoralin plus light, ozone, and ultraviolet light at 265 and 280 nM. Double-labeling experiments with tritiated and cold 5-bromodeoxyuridine, differential fluorescence and autoradiography were begun, in order to test whether induced sister chromatid exchange always involves all four DNA polynucleotide strands. (auth)

14451 (MBL-1973-12) MECHANISM OF SENSITIZATION OF LIVING CELLS TO IONIZING RADIATION BY OXYGEN AND OTHER RADIOSENSITIZERS. van Hemmen, J. J.; Meuling, W. J. A.; van der Schans, G. P.; Bleichrodt, J. F. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 10p.

A new hypothesis for the mechanism of sensitization of living cells is proposed. In a cell the DNA is surrounded by many chemical compounds. These compounds may react with radioinduced damage in DNA, or radioinduced radicals of these compounds may react with DNA. It is now suggested that sensitizers and oxygen may influence one or more of these radioinduced reactions of cell compounds with DNA, viz., they exert their sensitizing effect on cells because of the presence of particular compounds in the cell. The experiments and results pointing to this hypothesis are described. DNA of the bacteriophage PM2 was used and cell suspension of E. coli, Pseudomonas and human cells. Paranitroacetophenone and 2,2,6,6-tetramethyl-4-piperidone-N-oxyl were used as sensitizers. (NL)

14452 (MBL-1973-15) INFLUENCE OF RAT BLOOD ON RADIATION PROTECTION OF MAMMALIAN CELLS BY CYSTEAMINE AND CYSTAMINE IN VITRO. Grant, G. A.; Vos, O.; Budke, L. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1973. 26p. (DREO-685).

The protective effect of cysteamine and cystamine on T-cells in normal growth medium was studied in the presence of whole rat blood (WRB). The protective effectiveness of both agents was increased by the addition of WRB. WRB increased the protective activity of cysteamine as much as 40-fold but it had much less effect on the activity of cystamine. A dose reduction factor of 1.5 was obtained with 0.05 mm cysteamine. The mechanism of the increase in the protection is discussed and it was considered that the increase in protection might be due to protector RS radicals reacting with rat red cells. (NL)

14453 (N-74-32534) BIOLOGICAL EFFECTS OF RADIATION, METABOLIC, AND REPLICATION KINETICS ALTERATIONS. Final Report. Post, J. (New York Univ., N. Y. (USA)). 31 Dec 1972. 19p. (NASA-CR-139689). NTIS $4.00.

The biological effects of radiation on normal and cancerous tissues were studied. A macromolecular precursor of DNA, 3ETdR, was incorporated into the cell nucleus during synthesis and provided intranuclear beta radiation. Tritium labeled cells were studied with autoradiographic methods; cell cycle kinetics were determined and cell functions modified by radiation dosage or by drugs were also evaluated. The long-term program has included; effects of radiation on cell replication and the correlation with incorporated dose levels, radiation-induced changes in cell function, viz., the response of beta irradiated spleen lymphocytes to antigenic stimulation by sheep red blood cells (SRBC), kinetics of tumor and normal cell replication, and megakaryocyte formation and modification by radiomimetic drugs. (auth)

14454 (N-74-33529) EFFECT OF CONTINUOUS LOW DOSE-RATE GAMMA IRRADIATION ON CELL POPULATION KINETICS OF LYMPHOID TISSUE. Final Report. Foster, B. R. (Grambling Coll., La. (USA)). 4 Oct 1974. 35p. (NASA-CR-140114). NTIS $4.75.

Cellular response and cell population kinetics were studied during lymphopoiesis in the thymus of the mouse under continuous gamma irradiation using autoradiographic techniques and specific labeling with tritiated thymidine. On the basis of tissue weights, it is concluded that the response of both the thymus and spleen to

continuous low dose-rate irradiation is multiphasic. That is, alternating periods of steady state growth, followed by collapse, which in turn is followed by another period of homeostasis. Since there are two populations of lymphocytes--short lived and long-lived, it may be that different phases of steady state growth are mediated by different lymphocytes. The spleen is affected to a greater extent with shorter periods of steady-state growth than exhibited by the thymus. (auth)

14455 (SGAE-2353) DNA REPAIR MECHANISMS IN LUPUS ERYTHEMATOSIS. Sandhofer, M.; Kerl, H.; Tuschl, H.; Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Oct 1974. 5p. (In German). (CONF-7409120-1). Dep. NTIS (US Sales Only) $4.00.

From 30th conference of the German Dermatologreal Society; Graz, Austria (10 Sep 1974).

Studies of the DNA repair mechanism in three patients with discoid lupus erythematosis were reported and the results were compared with earlier studies made in patients with systemic lupus erythematosis. The DNA repair was studied on the basis of unprogrammed DNA synthesis in peripheral lymphocytes after their isolation, irradiation at 30 krad, and incubation with ^{3}H-thymidine. The patients with lupus erythematosis showed a significantly reduced number of repairing cells than did lymphocytes from healthy persons. The number of labelled cells was also remarkably high. (JSR)

14456 X-RAY REPAIR REPLICATION IN L1210 LEUKEMIA CELLS. Lee, Y. C.; Byfield, J. E.; Bennett, L. R.; Chan, P. Y. M. (Univ. of California, Los Angeles). Cancer Res.; 34: No. 10, 2624-2633(Oct 1974).

Repair replication has been studied in detail in mouse L1210 leukemia cells. A method of identifying and quantitating repair replication using a pre- and postradiation block of normal replication with cytosine arabinoside is illustrated. The method derived does not require isolation of DNA per se and appears to be satisfactory for screening for inhibitors of repair replication. Repair replication can be demonstrated at doses in the 1000-rad range in bromouridine deoxyriboside-substituted cells and at slightly higher doses in nonsubstituted cells. Drugs that are known to bind to DNA inhibit this x-ray-induced repair replication. Drugs with these properties may be identified by the methods described and compared quantitatively in their ability to inhibit this type of x-ray damage. Since these phenomena can be demonstrated for low radiation doses and at drug concentrations attainable in vivo during human cancer chemotherapy this class of anticancer agent may be worthy of closer study. Application to the L1210 leukemia system should permit comparison of in vitro and in vivo drug effects in the context of the extensive in vivo pharmacological data already available for L1210 cells. (auth)

14457 ORGANIZATION AND REPAIR OF MAMMALIAN DNA. Lange, C. S. (Univ. of Rochester, NY). AT(30-1)-4282. FEBS (Fed. Eur. Biochem. Soc.) Lett.; 44: No. 2, 153-156(Aug 1974).

The following facts are demonstrated in the paper: that large pieces of native mammalian DNA can be measured by the use of neutral sucrose gradients; the size of this DNA; that this DNA consists of subunits joined together in tandem by linkages; and that double-stranded breaks in the DNA subunits and cleavage of the linkages are both repaired with what appears to be a first order kinetics, dose-independent rejoining rate. Two models are proposed, one for the organization of the DNA in the mammalian chromosome and the other for the explanation of cell survival curves in terms of DNA double-strand breaks. (ERB)

14458 SELECTIVE EXCISION OF GAMMA RAY DAMAGED THYMINE FROM THE DNA OF CULTURED MAMMALIAN CELLS. Mattern, M. R.; Hariharan, P. V.; Cerutti, P. A. (Univ. of Florida, Gainesville). Biochim. Biophys. Acta; 395: No. 1, 48-55 (Jun 1975).

Three mammalian cell lines (WI-38, SV40-transformed WI-38, and Chinese hamster ovary) were exposed to high doses of ^{137}Cs gamma rays and their DNA analyzed, following various periods of postirradiation incubation, for products of the 5,6-dihydroxydihydrothymine type. Within fifteen minutes of incubation at 37°C, 70 to 90 percent of these radiation products were removed from acid-precipitable material in all three cell lines. The amount of DNA degradation induced by radiation varied from approximately one percent in WI-38 cells to 15 percent in SV40-transformed WI-38 cells. Comparison of DNA degradation with the amount of thymine radiation product removed indicates that a selective gamma ray-induced excision repair capability exists in mammalian cells. Because of its more rapid kinetics, gamma ray excision repair is probably a distinct process as compared with ultraviolet-induced pyrimidine dimer excision. (NL)

14459 REPAIR OF DNA STRAND BREAKS AFTER GAMMA-IRRADIATION OF PROTOPLASTS FROM CULTURED WILD CARROT CELLS. Howland, G. P.; Hart, R. W.; Yette, M. L. (Oak Ridge National Lab., TN). Mutat. Res.; 27: No. 1, 81-87 (Jan 1975).

Protoplasts of cultured wild carrot (Daucus carota L.) cells were isolated, lysed directly on top of alkaline sucrose gradients, and single-strand DNA of molecular weight 1.10^{8} to 2.10^{8} was measured by velocity sedimentation. DNA sedimentation studies on γ-irradiated protoplasts indicate that the energy absorbed in DNA per strand break is 85 eV in air and 260 eV in nitrogen. Isolated wild carrot protoplasts can repair 50% of the DNA strand breaks within 5 min after a dose of 20 krad, and by 1 h none can be detected. (NL)

14460 HUMAN LEUKOCYTE TEST SYSTEM. III. Premature Chromosome Condensation from Chemically and X-ray Induced Micronuclei. Obe, G. (Freie Univ., Berlin); Beek, B.; Vaidya, V. G. Mutat. Res.; 27: No. 1, 89-101(Jan 1975).

Premature chromosome condensation (PCC) was induced in human leukocytes in vitro by a bifunctional alkylating agent 2,5-bis-(methoxyethoxy)-3,6-bis-ethylene-imino-p-benzoquinone, bleomycin and x rays. Analysis shows that PCC originates from micronuclei slowed down in their cell cycles in respect to the main nuclei. The mitosing chromatin of the main nuclei induced PCC in the associated micronuclei. Morphologically the PCC was mostly of the S-phase type with the chromatin exhibiting a more or less pulverized appearance; in some experiments this was verified by incorporation of ^{3}H-thymidine. In a few cases the PCC looked like G2-phase PCC with ladder-like chromosomes. (NL)

14461 MECHANISM OF PRODUCTION OF CHROMOSOMAL ABERRATIONS BY ULTRAVIOLET RADIATION. Luchnik, N. V. (Inst. of Medical Radiology, Obnisk, USSR). Mutat. Res.; 27: No. 2, 295-298(Feb 1975).

14462 IDENTIFICATION OF DICENTRIC CHROMOSOMES IN IRRADIATED LYMPOCYTES BY C-BANDING. Prosser, J. S. (National Radiological Protection Board, Harwell, Eng.). Mutat. Res.; 27: No. 1, 131-133(Jan 1975).

14463 NEUROBLASTOMA: THE ESCHERICHIA COLI OF NEUROBIOLOGY. Haffke, S. C.; Seeds, N. W. (Univ. of Colorado Medical Center, Denver). Life Sci.; 16: No. 11, 1649-1658(1 Jun 1975).

Changes in morphology in various clonal lines of neuroblastoma cells are described. Morphological changes were induced by FUDR, cytosine arabinoside, x radiation, and hypertonic culture media. Biochemical changes induced by x radiation and other agents in neuroblastoma cultures are tabulated. These changes include increased activities of acetyl cholinesterase, choline acetyltransferase, tyrosine hydroxylase, glutamate dehydrogenase, and lactate dehydrogenase. (HLW)

14464 BIOLOGICAL EFFECTS OF THE LOS ALAMOS MESON BEAM ON CELLS IN CULTURE. Raju, M. R.; Dicello, J. F.; Trujillo, T. T.; Kligerman, M. M. (Los Alamos Scientific Lab., NM). Radiology; 116: No. 1, 191-193(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(1 Dec 1974).

Preliminary measurements of the biological effects of negative pions on cells in culture are reported. Cell survival as a function of depth was obtained by using gelatin to suspend the cells. The results indicate that the effects are more pronounced at the peak portion of negative pions. Cell-survival curves were also obtained under oxygenated and hypoxic conditions. The biological effectiveness at the peak was found to be a factor of 2.0 higher than at the plateau. The oxygen enhancement ratio was 1.5 at the peak. No significant differences in biological effects were observed above 14 mm in the peak region. (auth)

14465 SPATIAL DISTRIBUTION OF EFFECTS OF NEGATIVE PIONS ON CULTURED HUMAN CELLS. Todd, P.; Shonk, C. R.; West, G.; Kligerman, M. M.; Dicello, J. (Los Alamos Scientific Lab., NM). Radiology; 116: No. 1, 179-180(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(1 Dec 1974).

Cultured human kidney T-1 cells were irradiated in flasks or on coverslips at different depths in a water phantom using the Los Alamos Meson Physics Facility Biomedical negative pion beam. Postirradiation colony formation and cell multiplication were assayed. Maximum cell inactivation occurred in the vicinity of maximum pion dose. Comparison of dose-survival curves with those found following x irradiation indicated RBE equals 1.4 +- 0.3 for colony formation and approximately 1.5 for growth delay. Delivery of 400 pion rads in four fractions resulted in higher survival than did delivery of 400 rads in a single fraction. (auth)

14466 SIMULTANEOUS APPLICATION OF PULSED HIGH FREQUENCY CURRENTS AND GAMMA RAYS TO CULTURED MELANOMA CELLS. Haekkinen, A. M.; Blomqvist, K.; Spring, E. (Helsinki Univ. (Finland). Radiotherapy Clinic); Valtonen, E. (Helsinki Univ. (Finland). Dept. of Physical Medicine). Strahlentherapie; 149: No. 2, 205-207(1975).

Cells differentiated from a human metastasizing melanoma have been irradiated simultaneously with pulsed high frequency currents (27.12 MHz, 400 to 600 pulses/s, pulse duration 65 μs, average power 25 to 38 watt) (Diapulse), and gamma radiation from a ^{60}Co source. Simultaneous pulsed high frequency field and gamma radiation acted in a way resembling a cell-protecting mechanism, enhancing the number of surviving cells to the extent of about 15% as compared with the cell number scored after pure ^{60}Co-gamma-radiation treatment. Irradiation with pure high frequency currents resulted in increasing cell death for a period of up to 4 minutes; subsequently, this seemed to be almost independent of time. The number of cells which survived, as compared with the controls, was found to be approximately 80%, near a distance of 6.5 cm from the symmetry axis, perpendicular to the plane of the radiating element. (auth)

14467 BIOLOGICALLY EFFECTIVE DOSES FROM CALIFORNIUM-252 INTRACAVITARY APPLICATIONS. Iyer, P. S. (Bhabha Atomic Research Centre, Bombay (India). Directorate of Radiation Protection). Strahlentherapie; 149: No. 2, 185-187 (1975).

Californium-252 which emits fission neutrons and gamma rays is being investigated for applications in brachytherapy. From available experimental results, a value of 6.2 has been arrived at as the RBE for cell killing of californium neutrons relative to radium gamma rays for intracavitary applications based on the revised Manchester system of loading. The LET distributions as well as the ratio of neutron to gamma dose-rates have been estimated and are found to remain almost constant in the volume of interest around such applications. (auth)

14468 FRACTIONATED DOSE OF 35-MeV FAST NEUTRONS AND HYPOXIC TUMOR CELL SURVIVAL CURVE. U, R.; Evans, J. C.; Cavanaugh, P. J.; Abramson, N.; Thompson, T. T.; Wheless, D. M. (Duke Univ., Durham, NC). Cancer; 35: No. 6, 1658-1663 (Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

The determination of the RBE for the MANTA fast neutrons produced by NRL is in progress, with the model system using tumor cell population kinetic response patterns assayed in vitro after irradiation in vivo. Ascites tumor cells BW-5147 were irradiated with a clinically usable fast neutron beam from the NRL cyclotron, which is produced by accelerating deuterons to 35 MeV and using them to bombard a thick beryllium target. The comparison of dose-effect relationships was made for doses ranging from 30 to 1000 rads. The doses required for an isoeffect on BW-5147 hypoxic tumor cell survival and impairment of its reproductive capacity from fast neutron exposure were not different whether it was given in a single dose or the same dose given in three fractions separated by long recovery periods in situ. No intracellular repair of sublethal injury of hypoxic cells was demonstrated with fast neutrons. The reference experiments with 250-kVp x rays, however, showed a considerable repair of sublethal injury when the dose was given in three fractions, although the hypoxic BW-5147 tumor cells have no effective reoxygenation or repopulation in this time interval. The RBE for the fast neutron beam is 4 relative to x rays for fractionated doses at the surviving fraction level of 0.6 to 0.7, while the RBE is 2.5 for single doses. However, at a surviving fraction of 0.1, the RBE is 1.9 for single and 2.8 for fractionated doses. Analysis of the daily cell population kinetic patterns showed that there was no difference for repopulation rate or mitotic delay between the two types of radiations at a similar level of survival. (auth)

14469 RADIOBIOLOGICAL STUDIES OF A HIGH-ENERGY MODULATED PROTON BEAM UTILIZING CULTURED MAMMALIAN CELLS. Robertson, J. B.; Williams, J. R.; Schmidt, R. A.; Little, J. B.; Flynn, D. F.; Suit, H. D. (Harvard Univ., Cambridge, MA). Cancer; 35: No. 6, 1664-1677(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

The modulated, 160-MeV proton beam produced by the Harvard Cyclotron has been examined in detail for its ability to kill mammalian cells as assayed by colony forming ability. Using two different cell exposure techniques, the characteristics of position and total dose in producing cell death in two aneuploid cell lines selected for their radiobiological relevance have been determined. The parameters which describe the survival curves after proton or ^{60}Co irradiation show no statistical differences, except on the distal portion of the final Bragg peak of the proton beam, where RBE increases to approximately 1.4. This increase in RBE results in extending the cell killing effect of the beam by approximately 2 mm. This effect may be of practical significance in the irradiation of tissue such as the pituitary where the position of the Bragg peak is of great importance. The overall killing efficiency ratio between the modulated high-energy proton beam and ^{60}Co gamma rays was 1.00 ± 0.01 (standard error). (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 14441, 14444, 14445, 14447, and 14553.

14470 (IBVL-426) QUALITY IN COOKING AND PROCESSING OF ELECTRON BEAM TREATED POTATOES. Buitelaar, N. (Instituut voor Bewaring en Verwerking van Landbouwprodukten, Wageningen (Netherlands)). Jun 1974. (In Dutch).

An experiment was started irradiating potatoes with electron beams after similar experiments with gamma radiation were terminated because the results were disappointing. Ten different species of potatoes were used. The potatoes were irradiated on two sides and stored in a cool place. Four times during the storage season samples were taken. The discoloration was measured in boiled potatoes, prefried chips (bars), and crisp (slices). For comparison the same was done with potatoes treated with a mixture of chemical sprout inhibitors (I.P.C. and C.I.P.C.). The results were as follows. Boiled potatoes: discoloration, which was constant throughout the season, occurred faster and was stronger in electron-irradiated potatoes, but it was much better than in the gamma radiation experiments. Prefried slices: for irradiated potatoes the color was less good in the beginning of the season but further equal to that of the chemically treated ones, and very much better than for the gamma-irradiated ones in previous experiments. Prefried bars: only a slight discoloration towards the end of the season and very little difference with chemically-treated potatoes; results far better than for gamma rays. Other organoleptic properties were tested and judged slightly better in chemically-treated potatoes. (NL)

14471 (JPRS-64929, pp 143-145) DEPENDENCE OF THE VIABILITY AND MUTABILITY OF CHLORELLA ON POST-RADIATION STORAGE CONDITIONS. Sakovich, I. S.; Vekshina, L. K. 18 Jun 1973. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 9: No. 2, 84-85(Mar 1975).

In Space Biology and Aerospace Medicine.

Chlorella is a possible representative of a closed life support system for a spaceship crew, and during the time of flight it will be exposed to cosmic radiation, and in particular, to periodic irradiation from solar flares. The reaction of Chlorella to fractional γ irradiation was studied in comparison with total single irradiation, and also the dependence of the radiobiological effect on the post-radiation conditions for survival of the culture. (auth)

14472 (SU-326P7-28) REPAIR OF DAMAGED DNA IN VIVO. Annual Progress Report, May 1, 1974-May 9, 1975. Hanawalt, P. C. (Stanford Univ., Calif. (USA)). May 1975. Contract AT(04-3)-326-7. 6p. Dep. NTIS $4.00.

Progress is reported on studies of DNA repair replication in toluenized Escherichia coli cells. The studies showed that either DNA polymerase II or DNA polymerase III can participate in uv-stimulated repair replication. (CH)

14473 COMPARISON OF RADIOSENSITIVITY OF BACTERIA ISOLATED FROM GIVEN RADIATION EXPOSURE HISTORY. Kim, K. S.; Min, B. H.; Rhee, K. S. Korean J. Microbiol.; 12: No. 2, 69-76(1974). (In Korean).

This experiment was carried out to identify and to compare the radiosensitivities of bacteria isolated from the sources of different radiation exposure histories. Among 10 strains isolated in this investigation four strains of bacteria, Bacillus firmus, Bacillus brevis, Bacillus subtilis, and Bacillus sphaericus were isolated from high- and low-radioactive sites simultaneously. Bacterial strains isolated from radioactive sources such as reactor and isotope production rooms were more resistant to irradiation than the microorganisms from medical products and laboratories, however, there was no significance in radiosensitivity in the same species of bacteria, even if they were isolated from different radiation exposure histories. (Korean Sci. Abstr.)

14474 IRRADIATION OF MEAT. I. Effect of Pasteurizing Doses on Salmonella, Staphylococci, and Streptococci. Simard, C.; Lachance, R. A.; Moreau, J. R. (Laval Univ., Quebec City, Canada). Can. Inst. Food Sci. Technol. J.; 6: No. 4, 250-253 (Oct 1973). (In French).

Raw ground beef meat wrapped in oxygen-permeable plastic film and wieners packaged under vacuum in oxygen-impermeable plastic film were irradiated with Cobalt-60. Before irradiation, beef samples were inoculated with Salmonella typhimurium. Wieners were inoculated with Staphylococcus aureus and strep-

tococcus faecalis. Irradiation doses of 385, 378, and 480 Krads respectively, were sufficient to inactivate bacteria under the experimental conditions used. (auth)

14475 BACTERIOSTASIS IN SOILS STERILIZED BY GAMMA IRRADIATION AND IN REINOCULATED STERILIZED SOILS. Davis, R. D. (King's Coll., London). Can. J. Microbiol.; 21: No. 4, 481-484(Apr 1975).

An agar-disc method was used to compare the bacteriostatic properties of five soils with those of samples of the same soils sterilized by gamma irradiation. For three of the soils, bacteriostasis was removed either partially or entirely by sterilization. Bacteriostasis was completely restored to sterile soil by reinoculating it with natural soil. All the reinoculation treatments restored the level of bacteriostasis equally effectively, whatever the origin of the soil used as inoculum. (auth)

14476 GROWTH OF CRYPTOCOCCUS NEOFORMANS IN UV-IRRADIATED EXCRETA OF PIGEONS. Hubalek, Z.; Prikazsky, Z. (Inst. of Parasitology, Prague). Folia Microbiol. (Prague); 20: No. 3, 231-235(1975).

Ultraviolet irradiation of pigeon droppings resulted in an increased concentration of some inhibitors (peroxides) of growth of Cryptococcus neoformans. This may be, in addition to the direct germicidal action of sunshine, another cause of the rare occurrence of this fungus in pigeon droppings on unsheltered sites in natural habitats. (auth)

14477 MUTANTS OF ESCHERICHIA COLI EXCRETING DEOXYRIBONUCLEASAS. Markiewicz, Z.; Kwiatkowski, Z. (Warsaw Univ.). Acta Microbiol. Pol., Ser. A; 7: No. 2, 107-111(1975).

The purpose of this study was to isolate mutants of Escherichia coli K-12 excreting during growth to the medium deoxyribonucleases and to determine whether this activity is responsible for endonuclease I known to be located in the periplasm or whether other nucleolytic activities are present. As a result of mutagenesis with nitrosoguanidine and plating on selective media, eleven leaky mutants of strain F-JC411 were isolated. Growth rates, viability, and sensitivity to the surfactants sodium dodecyl sulphate and sodium deoxycholate were approximately the same for both the mutants and parental strain. On the assumption that leakiness of a deoxyribonuclease activity might result in altered characteristics of processes involving deoxyribonuclease, the mutants were also tested for change in recombination proficiency and sensitivity to uv radiation. All the mutants were found to give in crosses with Hfr and F' donors a similar number of recombinants as the parental strain. Also no appreciable differences were observed in both sensitivity to uv radiation and degradation of DNA after uv irradiation. None of the mutants were temperature sensitive. (ERB)

14478 CHROMOSOME ABERRATIONS IN HUMAN LYMPHOCYTES AFTER IRRADIATION WITH 15.0-MeV NEUTRONS IN VITRO. I. Dose-Response Relation and RBE. Bauchinger, M.; Schmid, E.; Rimple, G.; Kueh, H. (Gesellschaft fuer Strahlen- und Umwelt Forschung mbH, Neuherberg, Ger.). Mutat. Res.; 27: No. 1, 103-109(Jan 1975).

Human peripheral lymphocytes were irradiated with different doses of 15.0-MeV neutrons. The frequency of different aberration types was determined and the dose-response relation was calculated. The data were fitted by least-squares regression analysis to different models. The dicentric, dicentric + centric ring, and different acentric data gave the best fit to the linear quadratic model. The RBE of 15.0-MeV neutrons versus 220 kV x rays decreased significantly with increasing dose. (NL)

14479 EFFECTS OF DNA POLYMERASE-DEFECTIVE AND RECOMBINATION-DEFICIENT MUTATIONS ON THE ULTRAVIOLET SENSITIVITY OF BACILLUS SUBTILIS SPORES. Munakata, N.; Rupert, C. S. (Univ. of Texas, Dallas). Mutat. Res.; 27: No. 2, 157-169(Feb 1975).

The DNA of uv-irradiated Bacillus subtilis spores, which contains 5-thyminyl-5,6-dihydrothymine (TDHT) as the major thymine photoproduct, is known to be repaired during germination by two complementary mechanisms: excision repair, and "spore repair", a special process, which destroys TDHT in situ without rendering it acid-soluble. In the absence of both mechanisms TDHT is not removed, and spores are highly uv-sensitive. When either of two mutations giving defective DNA polymerase or one giving a recombination deficiency are introduced into strains defective in one of these known TDHT removal processes, the chemically measured elimination of TDHT from spore DNA is unaltered, but spore uv-sensitivity is increased. The pol-mutations produce their greatest sensitivity increase in spores of strains already deficient for the in situ destruction of TDHT, while the rec-mutation gives its maximum sensitivity increase to spores of strains lacking excision. These facts argue that the pol-mutations interfere mostly with excision repair (presumably its later resynthesis step), while the rec-mutation impairs "spore repair" in some step occurring subsequent to the TDHT destruction in situ. With either of these impairments of the later repair steps, DNA of uv-irradiated and germinated spores is considerably degraded, unless germination is carried out in the presence of chloramphenicol. (NL)

14480 ULTRAVIOLET-INACTIVATION OF CONIDIA FROM HETEROKARYONS OF NEUROSPORA CRASSA CONTAINING uv-SENSITIVE MUTATIONS. Shelby, M. D. (Union Carbide Corp., Oak Ridge, TN); de Serres, F. J.; Stine, G. J. Mutat. Res.; 27: No. 1, 45-58(Jan 1975).

The effect of three uv-sensitive mutations of Neurospora crassa, upr-1, uvs-4 and uvs-6, on the ultraviolet-inactivation of conidia from two-component heterokaryons was investigated. In two-component heterokaryons with wild-type sensitivity to radiation inactivation, all three conidial fractions exhibited similar ultraviolet-inactivation curves. Each uv-sensitive mutation studied uniquely modified the ultraviolet-inactivation curves of conidia from two-component heterokaryons. In heterokaryons heterokaryotic for upr-1, the upr-1 mutation was recessive and the repair function determined by the wild type allele was functional to some degree in homokaryotic upr-1 conidia. All three conidial fractions of heterokaryons containing upr-1 in both components showed increased sensitivity to ultraviolet light. The uvs-4 mutation was recessive and resulted in conidia with increased uv-sensitivity only when included in both components of a heterokaryon. The uvs-6 mutation, when included in one component of a two-component heterokaryon, resulted in increased uv-sensitivity of both heterokaryotic and homokaryotic uvs-6 conidia. When both components contained uvs-6, the uv-sensitivity of all three conidial fractions was increased and all showed similar inactivation curves. (NL)

14481 NON-EQUIVALENCE OF YEPD AND SYNTHETIC COMPLETE MEDIA IN YEAST REVERSION STUDIES. Murthy, M. S. S.; Rao, B. S.; Reddy, N. M. S.; Subrahmanyam, P.; Madhvanath, U. (Bhabha Atomic Research Centre, Bombay). Mutat. Res.; 27: No. 2, 219-223(Feb 1975).

In yeast reversion studies, assay of the total number of cells is made by plating irradiated cells on agar plates containing yeast extract, peptone and dextrose (YEPD) medium. The number of revertants are scored by plating cells on synthetic complete (SC) medium deficient in the particular nutrient for which the reversion is tested. In this procedure equivalence for cell survival between the YEPD and the SC media is always assumed. However, it is shown that this assumption is valid only up to dose levels where cell killing is not significant. At high doses, survivals on the two media differ significantly from each other for both high and low LET radiations. This difference influences the slope of the reversion frequency curve at high doses. Since the reversion frequency is expressed with reference to the number of survivors after a given radiation dose, it is essential to see that the same chance of survival is offered to the reverted and unreverted cells. (NL)

14482 MUTATION AND NUCLEAR STAGE IN SCHIZOSACCHAROMYCES POMBE. I. An Experimental Approach to the Role of Recombination in Mutation Induction. Abbondandolo, A. (Consiglio Nazionale delle Ricerche, Pisa, Italy). Mutat. Res.; 27: No. 2, 225-233(Feb 1975).

A reverse mutation system using G1 and G2 cells of Schizosaccharomyces pombe is described. In order to enable the system to deal with the problem of mutation dependence on recombination, tests were performed on 1) the homogeneity of cell populations with respect to nuclear stage; 2) the fate of cells during post-irradiation incubation; 3) the colony-forming ability of G1 and G2 revertants; and 4) cell viability on the mutation plates. On the basis of the results, it is thought that, using this system, information can be obtained on the role of recombinational events in the process of mutation induction. (NL)

14483 MUTATION AND NUCLEAR STAGE IN SCHIZOSACCHAROMYCES POMBE. II. Reverse Mutations Induced by X-Rays in the Absence of Recombination. Rainaldi, G.; Abbondandolo, A. (Consiglio Nazionale delle Richerche, Pisa, Italy). Mutat. Res.; 27: No. 2, 235-240(Feb 1975).

Induction of mutations by x rays in Schizosaccharomyces pombe cells in which sister-strand recombination appears to be excluded is offered as evidence against a requirement for recombination in radioinduced mutagenesis. (NL)

14484 SURVIVAL AND ABILITY TO SYNTHESIZE INTACT DNA MOLECULES AFTER ULTRAVIOLET IRRADIATION IN ESCHERICHIA COLI CELLS. Slezarikova, V.; Masek, F.; Sedliakova, M. (Slovak Academy of Sciences, Bratislava). Biochim. Biophys. Acta; 390: No. 1, 28-32(16 Apr 1975).

A correlation was found to exist between the capacity of cells to synthesize intact DNA molecules following ultraviolet irradiation and survival. Various Echerichia coli strains, proficient in excision and recombination repair, but varying in sensitivity to ultraviolet radiation, have a differing ability to join the newly synthesized DNA. As the time of synthesis of the intact DNA molecule increased, the fraction of surviving cells became smaller (NL)

14485 INEFFECTIVENESS OF RIFAMPICIN IN INHIBITING RNA SYNTHESIS IN ESCHERICHIA COLI AND T_4-INFECTED ESCHERICHIA COLI CELLS AFTER EXPOSURE TO ULTRAVIOLET RADIATION. Prakash, R. K.; Netrawali, M. S.; Pradhan, D. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay) Biochim. Biophys. Acta; 383: No. 4, 435-440(2 Apr 1975).

Residual RNA synthesis in Escherichia coli cells and T_4-infected E. coli cells exposed to ultraviolet radiation is insensitive to rifampicin. On the other hand, residual RNA synthesis in cells after gamma irradiation is further inhibited by rifampicin. The specific effect exerted by ultraviolet irradiation on transcription seems to arise from alterations in the DNA structure rather than in bacterial RNA polymerase since RNA synthesis in ultraviolet-irradiated E. coli cells infected with unirradiated T_4 is sensitive to rifampicin. (NL)

14486 GENETIC AND PHYSIOLOGICAL ANALYSIS OF AN envB SPHERELIKE MUTANT OF ESCHERICHIA COLI K-12 AND CHARACTERIZATION OF ITS TRANSDUCTANTS. Westling-Haggstrom, B.; Normark, S. (Univ. of Umea, Sweden). J. Bacteriol.; 123: No. 1, 75-82(Jul 1975).

The envB1 mutation mediating a distorted cell morphology of Escherichia coli K-12 was cotransducible with strA, aroE, aspB, and argG. The mapping data is consistent with a gene location for envB around 62.5 min. In partial diploids envB1 was recessive to its wild-type allele. The original envB mutant contained a second mutation in a locus denoted sloB close to strA. The following gene order is suggested: sloB-strA-aroE-envB-aspB-argG. The sloB1 mutation caused a marked reduction in the growth rate of both envB and $envB^+$ strains. Moreover, this mutation in the presence of envB1 appears to increase the ratio between deoxyribonucleic acid and protein in cells growing in rich medium. The phenotypic properties of envB1, $sloB^+$, and $envB^+$ transductants were characterized. Cells with envB1, $sloB^+$ genotype were hypersensitive to several penicillins including the beta-lactam compound, amidino penicillin. Penicillin hypersensitivity could not be explained by increased outer membrane penetrability. The original envB mutant (envB1,sloB1), as well as envB1, sloB1 or $envB^+$, sloB1 transductants were resistant to amidino penicillin. Resistance was explained by the slow growth rate medicated by the sloB1 mutation. The similarity between envB cells and wild-type cells treated with sublethal concentrations of amidino penicillin was emphasized. (auth)

14487 MUTANT OF THE YEAST SACCHAROMYCOPSIS LIPOLYTICA THAT ACCUMULATES AND EXCRETES PROTOPORPHYRIN IX. Bassel, J.; Hambright, P.; Mortimer, R.; Bearden, A. J. (Univ. of California, Berkeley). J. Bacteriol.; 123: No. 1, 118-122(Jul 1975).

The red, water-insoluble pigment excreted by a mutant strain of the yeast Saccharomycopsis lipolytica is shown to be protoporphyrin IX. In genetic crosses the red phenotype has the properties characteristic of a defect in a single, recessive nuclear gene. The yield and ease of harvest of protoporphyrin IX from the yeast mutant indicate that this strain or its derivatives may be a valuable source of this substance. (auth)

14488 GENETIC AND KINETIC EVIDENCE FOR DIFFERENT TYPES OF POSTREPLICATION REPAIR IN ESCHERICHIA COLI B. Sedgwick, S. G. (Oak Ridge National Lab., TN). J. Bacteriol.; 123: No. 1, 154-161(Jul 1975).

The changes in molecular weight of deoxyribonucleic acid (DNA) synthesized after ultraviolet irradiation of Escherichia coli WP2, uvrA, and strains additionally mutant at polA, exrA, recA, and exrA and polA loci, were examined by alkaline sucrose gradient centrifugation. In a repair-deficient uvrA recA strain, the frequency of breaks in newly synthesized DNA was equal to that for pyrimidine dimers in parental DNA. Measurements of the amounts and rates of postreplication repair of these breaks indicate that repair is two to three times faster when DNA polymerase I is present, although almost all breaks are repaired regardless of DNA polymerase I activity. Increased ultraviolet doses lead to an increase in the proportion of breaks remaining unrepaired in uvrA recA, uvrA exrA, and uvrA exrA polA strains. The numbers of unrepaired breaks resemble the numbers expected if repair of one lesion is prevented by proximity of a second lesion. (auth)

14489 LAMBDA BACTERIOPHAGE GENE PRODUCTS AND X-RAY SENSITIVITY OF ESCHERICHIA COLI: COMPARISON OF RED-DEPENDENT AND GAM-DEPENDENT RADIORESISTANCE. Trgovcevic, Z.; Rupp, W. D. (Yale Univ., New Haven). J. Bacteriol.; 123: No. 1, 212-221(Jul 1975).

When gene products of lambda bacteriophage are introduced into a cell by transient induction of a lysogen, increased resistance of the cells to x rays results. This phenomenon has been called phage-induced radioresistance. Genetic studies show at least two classes of induced radioresistance. The first type depends on the products of the lambda red genes and is observed in bacteria that are mutated in the recB gene. It is thought that the lambda red products compensate for the missing RecBC nuclease in the repair of x-ray damage. An optimal effect is obtained even when the lambda red products are supplied 1 h after irradiation. The lesions that are affected by the red-dependent process are probably not deoxyribonucleic acid strand breaks because the extent of deoxyribonucleic acid strand rejoining is not altered by the red products. The second type of phage-induced radioresistance requires the gam product of lambda and is observed in wild-type and polA strains. The lambda gam^+ gene product must be present immediately after irradiation to exert its full effect. In its presence, DNA breakdown is decreased, and a greater fraction of DNA is converted back to high molecular weight. Strains carrying lex, recA, or certain other combinations of mutations do not show any detectable phage-induced radioresistance. (auth)

14490 RECOVERY OF HIGH FREQUENCY OF DIKARYOTIC CELLS FOLLOWING ULTRAVIOLET IRRADIATION OF DIKARYONS OF SCHIZOPHYLLUM COMMUNE. Parag, Y.; Giami, S. (Hebrew Univ., Jerusalem). Mutat. Res.; 27: No. 1, 127-130 (Jan 1975).

Radiation Effects on Plants

Refer also to abstract 14553.

14491 (SRO-637-4) DEVELOPMENT OF NEW TECHNIQUES OF USING IRRADIATION IN THE GENETIC IMPROVEMENT OF WARM SEASON GRASSES AND ASSESSMENT OF THE GENETIC AND CYTOGENETIC EFFECTS. Report Period, May 1, 1974–April 30, 1975. Burton, G. W.; Hanna, W. W. (Georgia Univ., Tifton (USA). Georgia Coastal Plain Experiment Station). 1975. Contract AT(38-1)-637. 40p. Dep. NTIS $5.00.

The following studies were conducted: altering protein quantity and quality in pearl millet grain by irradiation and mutation breeding; gamma-radiation breeding of sterile triploid turf Bermuda grasses; irradiation breeding of sterile coast cross-1, a forage grass hybrid, to increase winter hardiness; heterosis resulting from crossing specific radioinduced mutants with their normal inbred parent; economic assessment of radioinduced mutants; use of irradiation to induce resistance to rust disease; production of homozygous translocation tester stocks; use of radiation to control reproductive behavior in plants; and genetics of radioinduced mutations. (HLW)

14492 SELECTIVE BREEDING OF THE NEW STERILE MALE SYSTEM OF CORN. (League Inst. of Agricultural Science, Liaoning Province, China). I-ch'uan-hsueh T'ung-hsun; No. 3, 21-24(Sep 1974). (In Chinese).

Assisted by the Mongolian Institute of Physics, the Chao-wu-ta League Institute of Agricultural Science used cobalt-60 gamma rays to treat seeds of several varieties of corn for selective hybridization in the spring of 1961 and a new hybrid corn was subsequently produced. Its characteristic of sterile male has by now been established for fifteen generations. It was named Shuang-26. This paper reports the process of producing the hybrid, its major characteristics, its problems of heredity, and its value in productive application. (JPRS)

14493 EFFECT OF THERMAL NEUTRON IRRADIATION ON GLYOXYLATE CYCLE IN GERMINATING SOYBEAN SEEDS. Paek, I.; Lee, K. B. Korean Biochem. J.; 7: No. 1, 47-52(1974).

The effects of thermal neutron irradiation on the activities of the two key enzymes in glyoxylate pathway, i.e., malate synthetase and isocitritase in the germinating soybean seeds were studied. The activity of condensing enzyme has shown an increased activity after neutron irradiation. Decreased tendency of incorporation of acetate-2-^{14}C into malate and glyoxylate after neutron irradiation suggests the activities of both isocitritase and malate synthetase were inactivated by neutron irradiation. (Korean Sci. Abstr.)

14494 PRODUCTION OF STAMINATE STERILITY IN COTTON FLOWERS BY TREATMENT WITH COBALT-60. Lin, H. (Regional Agricultural Research Inst., Shansi, China). I-ch'uan-hsueh T'ung-hsun; No. 2, 31-34(Jun 1974). (In Chinese).

A method of producing cotton flowers whose stamens are sterile is of importance in the breeding of cotton. Foreign research on

genetic causes of staminate sterility and on the breeding of varieties with this characteristic is discussed. In China, there has been some success in the production of varieties with sterile stamens by means of gamma-ray bombardment, effected by treatment with cobalt-60. Observable flower characteristics indicating sterility of the stamens are described. The effectiveness of the treatment varied from variety to variety. Of 45 varieties tested, 21 did not produce the desired mutation; the others produced from 1 to 6 plants each with total or partial staminate sterility. A cumulative dosage of 10,000 to 25,000 roentgens was usually sufficient; more than 35,000 roentgens usually killed the plant. Variations in total dosage and in dosage per unit time are described along with their results. The plants produced by this method are self-pollinated with the small quantity of effective pollen they produce or are pollinated with normal pollen – sometimes both methods are used with different flowers on the same plant – and selection carried on. (JPRS)

14495 RADIATION AND CHEMICAL INDUCED QUANTITATIVE VARIATION IN SORGHUM. Short Communications. Ramulu, K. S. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Lab. Applicazioni in Agricoltura). Z. Pflanzenzuecht.; 72: No. 3, 260-265(Oct 1974).

The effect of x- and gamma rays and EMS treatments was studied on some quantitative characters in M_1 to M_4 generations of a grain-cum-fodder variety (Co.18) of Sorghum subglabrescens for the induced polygenic variability. In the treated population, the mean values for plant height, weight of ear, and weight of grain decreased in the M_1, while there was not only a decrease, but also an increase in the mean of these characters in the M_2 generation, when compared to the control mean. In the M_3 and M_4 also, there was a decrease as well as increase in the mean of the characters in the treated population, but the mean of the treated population approached the control mean. The frequency distribution for various quantitative traits in the M_3 and M_4 showed that the incidence of polygenic variation in the positive and negative directions is nearly equal following mutagenic treatments. Radiation and EMS treatments induced an enhanced phenotypic and genotypic variance in the M_3 and M_4. The induced variability in the treated populations differed in magnitude in the different characters following various mutagenic treatments. Selection for normal-looking plants in the M_2 and for grain yield in the M_3 was effective in increasing the genetic variability in the treated population. (auth)

14496 EFFECT OF GAMMA IRRADIATION ON PLANT GROWTH IN SORGHUM VARIETIES. Naphade, D. S. Farm J. (Calcutta); 14: No. 9, 18-21(1973).

Gamma irradiation treatments were given to seeds of three sorghum varieties viz., N. J. 156, M-22-5-16, and M. C. K. 60 to study their effects in stem height and leaf area in R_1 and R_2 generations. In both generations significant reduction in height of stem with 40,000 R dose was recorded in N. J. 156 and M. 22-5-16. N. J. 156 in R_1 generation showed significant increase in height with lower doses and significant decrease in height in the highest dose (40,000 R). Leaf area in R_1 generation was reduced in all the three varieties at all doses of radiation and in R_2 generation a slight rise was recorded in all the varieties individually at the lowest dose (10,000 R). (Indian Sci. Abstr.)

Radiation Effects on Animals

Refer also to abstracts 13909, 14289, and 16044.

Man

Refer also to abstracts 13836, 13910, 13922, 13927, 14274, 14277, 14285, 14286, 14302, 14595, 14726, 15052, 16042, 16052, 16559, 16660, and 16691.

14497 (JPRS-64929) SPACE BIOLOGY AND AEROSPACE MEDICINE. Translation of Kosm. Biol. Aviakosmicheskaya Med.; 9: No. 2, 1-155(1975). 155p. NTIS.

Separate abstracts were prepared for three papers. Twenty-one additional papers discuss the selection and training of astronauts and various aspects of safety during space flights. (CH)

For abstracts of individual papers see: 14471, 14498, and 14552.

14498 (JPRS-64929, pp 88-95) RADIATION SAFETY IN FLIGHTS IN HIGH-ALTITUDE AIRCRAFT. Kovalev, E. E.; Petrov, V. M. 16 Feb 1972. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 9: No. 2, 54-59(Mar 1975).

In Space Biology and Aerospace Medicine.

The major sources of radiation hazard for flights of supersonic high-altitude aircraft, galactic and solar radiation, are described. Estimates of the equivalent dose rate at different distances from these sources are given. The estimates are compared with the radiation doses allowed for the average population and special personnel. It is concluded that specific measures are needed to provide radiation safety of the crews and passengers aboard supersonic aircraft. (auth)

14499 (KFKI-75-29) SOME REMARKS ON THE NATURAL RADIATION BURDEN OF POPULATION. Feher, I.; Gemesi, J.; Toth, A. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 9p. Dep. NTIS (US Sales Only) $4.00.

The population's radiation burden is due, in no small measure, to the natural radioactivity of building materials. An appropriate model has been developed for the calculation of the burden of the population from the concentration of radioisotopes in building materials. The external and internal radiation burden of Hungary's population were determined and the effect of new building technologies and materials on the radiation burden was studied. In dwellings built of precast concrete slabs containing low-activity ballast available in Hungary the radiation burden was found to be significantly lower than the present average. The increase in the contamination hazard expected from the peaceful uses of atomic energy could be compensated by reducing the average external radiation burden together with the average bronchial dose. This reduction ought, according to estimations based on simple assumptions, to amount to 1.6 mrem/year and 58 mrad/year, respectively, requiring acceptable excess cost. (auth)

14500 (LA-5969-PR) CONTAMINATION LIMITS FOR REAL AND PERSONAL PROPERTY. Progress report, July–December 1974. Healy, J. W.; Wenzel, W. J. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-ENG-36. 7p. Dep. NTIS $4.00.

Studies during this period were primarily devoted to the derivation of a simplified conceptual model of radiation doses resulting from contaminated objects. A four-part model consisting of sections on use, actions, pathways, and radiation dose is described. This model will permit study of the quantitative features for each part. (auth)

14501 (MBL-1974-21) CHEMICAL PROTECTION FROM IONIZING RADIATIONS. Vos, O. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 17p.

A review is given of research on chemoprotection during the last 25 years. Discovery, working mechanism, and degree of protection are discussed. Examples of agents active by a systemic pharmacological mechanism and at the cellular level are presented. The possibilities of protection in various organs, protection against various types of ionizing radiation, the limitation in the practical application in human beings and the importance for clinical use are described. It is concluded that no prophylactic agent for a large scale safe use in human beings has been discovered yet. Still the data known at present do not preclude further improvements in the development of a protective agent which can safely be used in human beings. (NL)

14502 (MBL-1974-28) EFFECTS OF IONIZING RADIATION ON THE IMMUNE RESPONSE. Brocades Zaalberg, O. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 16p. (In Dutch).

A short review is given of the effects of ionizing radiation on the immune response. Following an introduction on the function of the immune apparatus, the effect of the radiation on the different types of cells of the immune system is described. In conclusion the possible consequences of these effects on the prognosis of radiation victims is discussed. (NL)

14503 (NP-20456, pp vp Paper 1) BIOLOGICAL EFFECTS OF IONIZING RADIATION. Morgan, K. Z. (Georgia Inst. of Tech., Atlanta). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The following topics are discussed: historical review of internal and external exposure of man to radiation; linear vs threshold hypothesis; somatic vs genetic risk; and consequences of low level radiation exposure. (HLW)

14504 (NP-20456, pp vp Paper 25) EPA APPROACH TO ENVIRONMENTAL ANALYSIS AND CONTROL OF RADIATION. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The EPA approach is designed to be responsive to near term situations, cooperative with programs of other agencies, cost-effective in methodology, and preventive in long range scope. In addition to nuclear power, the EPA is concerned about exposure of populations to medical x rays, natural radioactivity in stones

used for building material, uranium and radium in fertilizer phosphates, and cosmic radiation at high altitudes. The following topics are discussed: EPA responsibilities; underlying principles; federal radiation standards and regulations; EPA methodology for developing standards; economics of risk reduction; future risk, risk distribution, and differing societal values; uranium fuel cycle standard; environmental plutonium standards; HTGR fuel cycle standard; federal radiation guidance; environmental impact statement reviews; and environmental surveillance. (HLW)

14505 STANDARD TECHNIQUE FOR ESTIMATING PATIENT EXPOSURE FROM PHOTOFLUOROGRAPHIC X-RAY MACHINES. Gaeta, N. A.; Burnett, B. M. DHEW Publication No. (FDA) 75-8007. Rockville, MD; Food and Drug Administration (1975). 24p. GPO.

A standard survey protocol must be used in comparing phototimed exposures of photofluorographic (PFG) machines. A sheet of copper large enough to cover the face of the camera hood, nominal 0.054-inch thick (1.37 mm), can be used as the basis for the survey. This will give the same exposure as a 25-cm chest at 85 kVp and 3 mm aluminum filtration. The recommended survey procedure is as follows: adjust the machine voltage to 85 kVp; tape the copper sheet over the face of the camera hood; ascertain the value of total filtration (should be greater than or equal to 2.5 mm Al); tape dosimeters at the center of the copper. With the dosimeters facing the x-ray tube, make a series of five exposures at 1-minute intervals; and develop the exposed films according to manufacturer's specifications. The processed films should have a net density of 0.6 and the base-plus-fog level should be approximately 0.2. All PFG machines should give an exposure of 200 mR or less, including backscatter, to a 25-cm human chest; the equivalent exposure to the copper sheet at a target-to-hood distance of 102 cm (40 inches) is 90 mR. A single and efficient exposure measurement can be made with a 200 mR low-energy dosimeter. If the exposure to the copper exceeds 90 mR, the unit should not be used until it is repaired (24). This same procedure can be used for all phototimed units. (auth)

14506 MURUROA BOMB TESTS. O'Connor, B. H. West. Aust. Inst. Technol. Gaz.; 6: No. 10, 2-4(Dec 1973).

A discussion is given of radiation hazards arising from the French nuclear weapons testing at Mururoa. An assessment is made of the likelihood of somatic and genetic radiation effects arising from nuclear fallout. It is argued that the continuance of atmospheric nuclear weapons testing will have a deleterious effect on the Australian community. (AT)

14507 PROCEEDINGS OF THE 6TH CONFERENCE ON RADIATION HYGIENE. I. Conference Held at Jasna Pod Chopkom, Czechoslovakia, November 27–29, 1973. Trnovec, T.; Stojkovic, J. (eds.). Hradec Kralove, Czechoslovakia; Purkyne Medical Research and Postgraduate Institute Press (1973). 172p. (CONF-731171-P1).

Separate abstracts were prepared for 22 papers presented in this part of the proceedings. (ERB)

For abstracts of individual papers see: 13799, 13918, 14314, 14315, 14364, 14508–14511, 14558, 14602–14604, 14609–14613, 14624, 14625, 15884, and 16198.

14508 QUESTION OF RADIATION EXPOSURE TO THE HANDS OF NUCLEAR MEDICINE TECHNICIANS. Husak, V. (Univ. Hospital, Olomouc, Czech.); Charamza, O.; Trousil, J.; Kukacka, R. pp 85-90 of Proceedings of the 6th conference on radiation hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press(1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Film dosimeters were attached to the hands of technicians to determine the dose received by the hands during the elution of a $^{99}Mo-^{99m}Tc$ generator. English (shielded) generators and German (unshielded) generators were elected during the determinations. The fact that the German generators were unshielded and the fact that the eluates required millipore filtration led to a higher dose when working with these generators than with the English generators. (ERB)

14509 RESULTS OF MONITORING PERSONNEL EXPOSED TO EXTERNAL RADIATION IN WORKPLACES OF NUCLEAR RESEARCH CENTRE AT REZ. Chysky, J.; Ivanovova, J. (Inst. of Industrial Hygiene in Uranium Industry, Pribram, Czech.). pp 111-115 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Personnel subject to the hazard of external gamma radiation in workplaces of the nuclear research centre at Rez have been monitored by film-badge meters since 1958. The films used and the method of processing enable to determine exposures from gamma radiation up to 4R with the accuracy of ± 25% and even higher exposures with lower accuracy, however. Each controlled person wears two badges attached on the left and right parts of the chest. The films are processed once a month. Only one of the two values found is put among personal records, namely the higher one. In the workplaces where a relatively higher risk of irradiation is to be expected, the exposure doses are measured also with ionization dosimeters, pocket meters, and small ionization chambers. Our work aimed at the hygienic evaluation of the results of measurement of 495 workers in 1961. Data on annual occupational exposures obtained from the Department of Hygiene and Work Safety of the Nuclear Research Institute were classified by the GIER computer according to the height of exposure and sex, age, qualification, time, and kind of work of the controlled persons according to an algorithm prepared by us. (auth)

14510 MONITORING OF INTERNAL CONTAMINATION BY WHOLE BODY COUNTING AND RADIATION HYGIENE PRACTICE. Chysky, J.; Lenger, V. (Inst. of Hygiene and Epidemiology, Prague). pp 117-124 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Whole-body counting of workers of the Nuclear Research Centre in Rez was started in 1963. In the first period until the end of 1968, altogether 64 measurements were carried out and in the second period from 1969 until the middle of 1972, there were 444 measurements. All measurements were carried out on the whole-body counter at the Department of Radiation Hygiene, Institute of Hygiene and Epidemiology, Prague. During the first period, the examined persons were, above all, from work-places at which there occurred extraordinary events accompanied by contamination of the surfaces, working clothes, and possibly of the body of the workers. In the second period, the first step was taken towards systematic control of persons from work-places at which, according to the present conception, the intake of radioactive substance resulting in a dose commitment exceeding 3/10 of the maximum permissible dose cannot be excluded. The workers for control measurements were selected according to the present results of measuring surface contamination, measurements of concentrations of radioactive substances in the atmosphere, according to the rate of accidents at the work place during the previous period, etc. The workers chiefly concerned, worked at the cyclotron laboratory, the department of radioactive waste disposal, the reactor, the department producing radioisotopes, the processing of fission products, the research of decontamination processes, and at the department of nuclear spectrometry. (auth)

14511 ANALYSIS OF THE CAUSES OF RADIATION ACCIDENTS AT A NUCLEAR CENTER. Chysky, J.; Sevc, J. (Inst. of Hygiene and Epidemiology, Prague). pp 125-128 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The causes of 108 small radiation accidents which occurred from 1957 till Jun 1973 at the Research Centre in Rez near Prague, are being analyzed. The analysis was carried out by means of the protocols of the Department of Hygiene and Work Safety at the Institute of Nuclear Research and with the record of our own investigations conducted since 1969. It is evident from the submitted material that the most frequent cause of accidents (unplanned increase of the personal exposure or dispersion of radioactive substances at which internal contamination cannot be excluded beforehand) lies in insufficient preparation and securing of work, and in human failure. Technical failure, unforseeable defects of operational and protective facilities are considerably less frequent reasons of danger to workers. (auth)

14512 COURSE OF ACCUMULATION OF RADIATION EXPOSURE AND THE RISK OF LUNG CANCER. Placek, V.; Sevc, J.; Thomas, J. (Inst. of Industrial Hygiene in Uranium Industry, Pribram, Czech.). pp 251-255 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The risk of lung cancer in relation to the different time course of accumulation of exposure to radon daughters was studied in a large group of uranium miners. The group was subdivided into

smaller groups according to age at the start of exposure, duration of the exposure group, and level of radiation exposure. The results suggest that the assumed linear relation between accumulated exposure to radon daughters and the frequency of lung cancer is not at variance with the results observed in the case of equable accumulation of exposure, and this seems to be the case also when the exposure rates were initially higher and decreased gradually. In the case of unequable accumulation of exposure, when the exposure rates increased towards the end of exposure, an irregular relation was observed, with a decrease in the frequency of lung cancer in the highest level of accumulated exposure. It is possible therefore that at lower levels of accumulated exposure or a yearly intake of radon daughters approaching the permissible intake, this non-linearity does not manifest itself clearly. (ERB)

14513 USE OF SOME BIOCHEMICAL INDICATORS OF THE EXPOSURE IN THE URANIUM INDUSTRY. Vich, Z.; Prochazka, J.; Brychtova, V. (Health Inst. of Uranium Industry, Pribram, Czech.). pp 331-335 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The direct relationship of the pentose phosphate pathway activity in erythrocytes of uranium miners to the environmental exposure time was found, further to the glutathione reductase activity and the cholesterol content in erythrocytes, respectively. Some differences in the content of several amino acids in plasma of uranium miners was also found. It is supposed that some of these tests would be used as a biological indicator of chronic radiation exposure. (auth)

14514 INTERACTION DISTANCE OF PRIMARY LESION IN THE FORMATION OF DICENTRIC CHROMOSOMES AFTER IRRADIATION OF HUMAN LYMPHOCYTES WITH 3-MeV ELECTRONS IN VITRO. Bauchinger, M.; Schmid, E.; Rimpl, G. (Gesellschaft fuer Strahlen- und Umwellforschung mbH, Neuherberg, Ger.). Mutat. Res.; 25: No. 1, 83-87(Oct 1974).

The rejoining distance for the formation of dicentric chromosomes in human lymphocytes is derived on the basis of microdosimetric concepts. For the formation of a dicentric chromosome, primary lesions produced by absorption events can interact within the nucleus over a distance of between 0.5 and 1.0 μ. The intercellular distribution of dicentric chromosomes is consistent with a Poisson distribution. (NL)

14515 RADIATION EXPOSURE AND SAFETY RECOMMENDATIONS. Haugejorden, O. (London Hospital Medical Coll.). Acta Odontol. Scand.; 32: No. 35, 11-14(1974).

Thesis.

In discussing whether or not radiography for dental epidemiological research is permissible from health physics aspects, account must be taken of the total exposure of the population to radiation. It is difficult to determine the amount of radiation to which a person has been exposed by the time a given age is reached, but some information on medical and dental radiography is available for the U.K. National Health Service (NHS). The number of dental treatments involving x rays nearly doubled from 1962 to 1970, NHS hospital examinations rose from less than 8 million in 1951 to over 32.9 million in 1970. Figures (unknown) for radiographic examinations in private medical and dental practice and in school and local authority dental services must be added. The conventional short cone, full-mouth periapical examination gives the highest skin dose, followed by the long cone technique, the lowest being given by orthopantomography, which may be further reduced by rectangular collimation. Somatic damage is unlikely but since the genetic dose is cumulative and no threshold has been established, caution seems justified. (NO)

14516 INDUCTION OF NON-ORGAN-SPECIFIC AUTOIMMUNE PHENOMENA BY RADIOTHERAPY. Berger, P. S.; Keiser, H. D.; Ghossein, N. A. (Albert Einstein Coll. of Medicine, Bronx, NY). Radiology; 116: No. 1, 215-216(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(1 Dec 1974).

Induction of autoimmune phenomena by radiotherapy was evaluated with fluorescent antinuclear antibodies (FANA), latex fixation, and C'3 complement. The 27 random serum samples obtained prior to radiotherapy revealed only a low C'3 in a patient with Hodgkin's disease and Sjogren's syndrome. The 33 random serum samples obtained after radiotherapy revealed seven positive values (five FANA, one latex fixation, and one C'3). The increase in positive values was statistically significant. (auth)

14517 6 MEV ROTATIONAL THERAPY WITH A MIDLINE SHIELD FOR SUPERFICIAL SKIN TUMORS. Son, Y. H.; Silverman, H.; Agostinelli, A. G. (Yale Univ. School of Medicine, New Haven). Radiology; 116: No. 1, 139-141(Jul 1975).

A 6 MeV photon energy rotational beam with a midline lead shield is applied to the convex surface of the lower extremity in the treatment of extensive Kaposi's sarcoma. Such innovation is conducive to uniform surface dose distribution with the smallest possible depth dose to deep-lying structures at this energy level. A case example and computerized composite isodose printouts are presented. (auth)

14518 MANAGEMENT OF SQUAMOUS CELL CARCINOMA OF THE ORAL TONGUE AND FLOOR OF MOUTH AFTER EXCISIONAL BIOPSY. Ange, D. W. (Univ. of Tennessee Memorial Hospital, Knoxville); Lindberg, R. D.; Guillamondegui, O. M. Radiology; 116: No. 1, 143-146(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (1 Dec 1974).

A review of the records of 23 patients with squamous cell carcinoma of the oral tongue and floor of mouth treated with irradiation after excisional biopsy has shown that: (a) Radiotherapy, primarily using interstitial radium implants, results in excellent local control of the primary area (100 percent) with preservation of function. (b) The frequency and severity of soft-tissue and bone necrosis may be reduced by not exceeding 5,500 to 6,000 rads from radium implants when only subclinical aggregates of cancer cells are probably present. (c) The incidence of subsequent neck disease is low, 8.7 percent (2 of 23 patients), and does not warrant routine elective irradiation of the cervical lymphatics. (auth)

14519 CHEMODECTOMAS INVOLVING THE TEMPORAL BONE. Tidwell, T. J.; Montague, E. D. (Anderson Hospital and Tumor Inst., Houston, TX). Radiology; 116: No. 1, 147-149(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (1 Dec 1974).

In a series of 19 patients with chemodectoma, two were treated surgically and 17 received radiotherapy. Sixteen of the 17 patients who received radiotherapy after biopsy or partial excision are without evidence of tumor progression 4 to 18 years following treatment. A tumor dose of 4,500 to 5,000 rads in 4½ to 5 weeks yields excellent control of tumor growth and is within the tolerance of surrounding brain tissue. (auth)

14520 TOTAL-LUNG IRRADIATION IN THE TREATMENT OF PULMONARY METASTASES. Baeza, M. R.; Barkley, H. T.; Fernandez, C. H. (Anderson Hospital and Tumor Inst., Houston, TX). Radiology; 116: No. 1, 151-154(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(1 Dec 1974).

Sixty-two patients with pulmonary metastases from a variety of primary malignant neoplasms were treated with total-lung irradiation. The incidence of radiation pneumonitis was 21 percent (13/62) overall, rising to 23 percent (9/39) in those receiving a tumor dose of 1,500 rads or more. Nine patients with radiation pneumonitis were given chemotherapy (actinomycin D) together with irradiation, and in this group the incidence of radiation pneumonitis was 25 percent. Five survivors, including four treated for metastatic Wilms's tumor, were treated more than 13 months prior to analysis without evidence of disease thus far. Total-lung irradiation for primary malignant neoplasms other than Wilms's tumor does not presently appear to be indicated. A dose of 1,500 rads in 2 weeks in conjunction with actinomycin D is recommended for metastatic Wilms's tumor. (auth)

14521 CLINICAL EXPERIENCES WITH AND EXTENSIONS OF THE APPLICATION OF THE GROOTE SCHUUR HOSPITAL—UNIVERSITY OF CAPE TOWN UNISOURCE APPLICATOR. Sealy, G. R. H.; Rapley, L. F.; Tucker, R. D.; Le Roux, P. L. M. (Groote Schuur Hospital, Cape Town). Radiology; 116: No. 1, 155-157 (Jul 1975).

Clinical experience with a cesium unisource afterloading skin applicator is reported and developments with this applicator are described. Because the applicator is easy to use and provides even dose distribution and minimum exposure of personnel, it may be superior to the conventional radium tube applicator. (auth)

14522 OPTIMIZATION OF DOSE DISTRIBUTIONS IN MOVING-STRIP THERAPY USING A MINICOMPUTER. Leavitt, D. D.; Campbell, D. W.; Stryker, J. A.; Sherwood, G. (Hershey Medical Center, PA). Radiology; 116: No. 1, 159-164(Jul 1975).

Optimized ^{60}Co dose distributions for the moving-strip technique were calculated for three patients using a PC-12 minicomputer program which corrects for field obliquity and changes in patient thickness. Beam profiles were measured using an ionization chamber in a water phantom. A Masonite phantom was constructed to simulate a patient and used to measure optimized and unoptimized midplane dose distributions by thermoluminescent dosimetry. Measured midplane doses agreed with computer-calculated doses

within experimental error. The computer optimization technique improved dose uniformity, reducing the midplane dose variation from +-12 to 13 percent to +-3 to 4 percent. (auth)

14523 CHROMOSOME ABERRATIONS IN HUMAN LYMPHOCYTES AFTER IRRADIATION WITH 15.0-MeV NEUTRONS IN VITRO. II. Analysis of the Number of Absorption Events and the Interaction Distance in the Formation of Dicentric Chromosomes. Schmid, E.; Bauchinger, M. (Gesellschaft fuer Strahlen- und Umwelt Forschung mbH, Neuherberg, Ger.). Mutat. Res.; 27: No. 1, 111-117(Jan 1975).

The rejoining distance for the formation of dicentric chromosomes in human lymphocytes after irradiation with 15.0-MeV neutrons has been derived on the basis of microdosimetric concepts. For the formation of a dicentric chromosome, primary lesions produced by absorption events can interact within the nucleus over a distance of at least 1.8 μm. The mean number of absorption events within this range is lower than for sparsely ionizing radiation. The intercellular distribution of dicentric chromosomes is consistent with a negative binomial distribution. (NL)

14524 RADIOBIOLOGICAL BASES OF THE APPLICATION OF IONIZING RADIATIONS IN MAN WITH REGARD TO THE EFFECT OF LOW DOSES: SOMATIC EFFECTS. Fritz-Niggli, H. (Zurich Univ. (Switzerland). Strahlenbiologisches Inst.). pp 24-35 of Information on X-rays Regulations. Braun, H.; Kossel, F.; Ladner, H. A.; Messerschmidt, O.; Stieve, F. E. (eds.). Stuttgart, F. R. Germany; Thieme (1974). (In German).

From 14th annual reunion of the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Wuerzburg, F. R. Germany (16 Nov 1973). With abstract.

Since increased interest is again being devoted to the somatic effects of ionizing radiation, a survey of various possibilities of somatic radiation effects is presented. Genetic changes in somatic cells and somatic crossing-over, radiation induced disturbances of development, and carcinogenesis are mentioned. It is concluded that certain somatic disturbances are induced even by small quantities of radiation and that, for instance, there is no minimum dose for tumor induction following irradiation of the child in utero and in the first few years of its life. For adults, the risk of radiation induced cancer is slightly lower, but even then an increase in the relative cancer hazard from 1 to 1.5 can be calculated for occupationally exposed persons for a permissible annual dose of 5 rem. It is emphasized that unnecessary exposure to any dose should be avoided and that, above all, medical exposures should be kept to a minimum. (GE)

14525 RADIATION-INDUCED CHROMOSOME ABERRATIONS IN HUMAN PERIPHERAL LYMPHOCYTES. Exposure to X Rays or Protons. Todorov, S. L. (Meditsinska Akademiya, Sofia (Bulgaria). Lab. of Radiation Microbiology). Strahlentherapie; 149: No. 2, 197-204(1975).

A quantitative analysis was carried out of structural chromosome aberrations in human peripheral lymphocytes exposed in vitro to 180 kV x rays or 50 MeV protons. Statistical treatment of experimental findings by least-squares technique showed a regressional relationship between dose administered and yields of various chromosome aberration types. Fitting of the data to four mathematical models indicated, for both radiation types, that two-break aberrations, total number of aberrations, and total of breaks are best fitted by the polynomial of second degree $Y = bD + cD^2$, while one-break aberrations and number of aberrant cells are best fitted by the model $Y = a + bD$. For all chromosome aberration types numerical values of the coefficients in these models are presented. (auth)

14526 THREE-DIMENSIONAL ISODOSES FOR RADIOTHERAPY IN STEREOSCOPIC REPRESENTATION. Busch, M. (Marburg Univ. (F. R. Germany). Radiologiezentrum). Strahlentherapie; 149: No. 2, 155-161(1975). (In German).

Three-dimensional isodoses can be calculated with the aid of computers, and recorded stereoscopically in a relatively inexpensive manner. A critical judgement is given concerning the clinical practical as well as the instructional value of stereoscopic representations of isodoses. (auth)

14527 SHORT TERM EFFECTS OF IONIZING RADIATION ON THE RECURRENT OR METASTATIC SKIN CANCER. A Quantitative DNA Study. McLaren, J. R.; Maruszczak, A. J.; Olkowski, Z. L. (Emory Univ., Atlanta, Ga. (USA). Div. of Radiation Therapy). Strahlentherapie; 149: No. 2, 166-172(1975).

A total of 72 smears from two cases of metastatic squamous cell carcinoma of the head and neck during radiation therapy were studied for DNA content. The percentage of aneuploid tumor cells in the range of lower ploidy was high in both cases and remained high throughout the treatment. The correlation between the percentage of aneuploid cells in metastatic squamous cell carcinoma and radiocurability of these lesions has been discussed. (auth)

14528 RELATIVE GENETIC EFFICIENCY OF 50 MeV PROTONS AS DERIVED FROM ANALYSES OF CHROMOSOME ANOMALIES IN HUMAN LYMPHOCYTES. Todorov, S. L. (Meditsinska Akademiya, Sofia (Bulgaria). Lab. of Radiation Microbiology). Strahlentherapie; 149: No. 2, 188-193(1975).

Based on quantitation of chromosome anomalies observed following in vitro irradiations of human lymphocytes, relative genetic efficiency (RGE) values were derived for 50 MeV protons relative to 180 kV x rays. These values indicated 50 MeV protons to be generally of similar efficiency as x rays in producing chromosome anomalies in human lymphocytes. However, detailed analysis by types of anomalies observed yielded different RGE values. Thus, 50 MeV protons were found to be 15% less efficient than x rays in producing two-break exchange type aberrations. And inversely, they were about 15% more efficient in producing one break types of aberrations. (auth)

14529 SOME ASPECTS OF IODINE METABOLISM IN RADIOIODINE-TREATED GRAVES' DISEASE. Koutras, D. A.; Pharmakiotis, A. D.; Rigopoulos, G. A.; Koukoulommati, A. S.; Sfontouris, J.; Mantzos, J.; Malamos, B. (Athens Univ. (Greece). Dept. of Clinical Therapeutics; Alexandra Hospital, Athens (Greece). Thyroid Section). Horm. Metab. Res.; 7: No. 1, 62-64(Jan 1975).

1 tab.; 21 refs.

Fifteen cases of Graves' disease were studied before and after euthyroidism was achieved with radioiodine treatment. In spite of the euthyroid status, the thyroidal ^{131}I-uptake and $PB^{131}I$ remained high. Measurements of the plasma inorganic iodine, the urinary iodine, and the absolute iodine uptake by the thyroid showed that the increased ^{131}I uptake was not due to iodine deficiency, but mainly to faulty utilization of the iodine trapped by the thyroid, probably because of an organification defect. The intrathyroidal exchangeable iodine pool was decreased in the treated patients, and this could adequately explain the high $PB^{131}I$ values in these cases. These results confirm the unreliability of in vivo studies for assessing the euthyroid status of ^{131}I-treated patients and provide an explanation for the discrepancy between clinical status and in vivo iodine tests. (auth)

14530 SURVEY OF MEDICAL RADIUM INSTALLATIONS IN WISCONSIN. Tapert, A. C.; Lea, W. L. DHEW Publication (FDA) 75-8022. Rockville, MD; Public Health Service (May 1975). 37p. GPO.

A radiation protection survey was performed at 70 medical radium installations in the State of Wisconsin. The requirements of the State's Radiation Protection Code were used as survey criteria. Radiation measurements of radium storage containers, radium capsule leakage tests, and monitoring of work surfaces for contamination were performed. Film badge monitoring data of whole body and extremity doses are presented for 221 individuals at 17 hospitals. Whole body doses during single treatments ranged from 10 to 1360 mrems per individual. The estimate of 500 mrems per treatment was determined as the dose aggregate to hospital personnel. Whole body doses from film badges are compared with analogous TLD doses. Four physicians and six technicians at nine hospitals participated in a study for monitoring the extremities with TLD. Cumulative extremity doses ranged from 28 to 6628 mrems per participant during the study. (auth)

14531 RADIATION EXPOSURE TO PERSONNEL IN A NEONATAL NURSERY. Poznanski, A. K.; Kanellitsas, C.; Roloff, D. W.; Borer, R. C. (Univ. of Michigan, Ann Arbor). Pediatrics; 54: No. 2, 139-141(Aug 1974).

Radiation dose to personnel in a neonatal nursery from scattered irradiation from mobile radiographs can be kept at a level below background if certain simple precautions are observed. These consist of staying one foot or more away from the baby that is being radiographed and avoiding the direct beam when lateral cross table films are obtained . (auth)

14532 RADIATION DOSES IN MAMMOGRAPHY. Measurements on Phantoms and Patients. Kupka, K. Erlangen, GE; Erlangen Univ. (1973). 14p. (In German). INIS.

Thesis.

The question of whether the radiation doses involved in mammography allow an annual check-up of women during reproductive age is discussed. The measurements were done on an Alderson-Rondo-Man-phantom and six patients. Besides the skin exposure, the dose in the gonadal and eye region was determined. In a further experiment using a plexiglas phantom the dependence of the surface exposure on the thickness of the irradiated region and on the radiation quality was evaluated. The maximum value of the radiation exposure on the chest surface was 10 R. The measured

dose in the gonadal region was 0.01 to 0.015 mR and the eye dose was 0.4 to 0.5 mR, depending on voltage and beam direction. (GE)

14533 TREATMENT OF RADIONECROSIS OF THE WRIST USING A GREAT OMENTUM FLAP AND SKIN GRAFT. Martin, F. F.; Le Quang, C.; Texier, M.; Bonnet, F.; Dufourmentel, C. (Hopital Saint-Louis, Paris). Ann. Chir. Plast., Sem. Hop.; 19: No. 3, 247-249(1974). (In French).

A case of radionecrosis of the wrist induced by prolonged exposure to a ^{60}Co source without necessary safeguards and its successful treatment by plastic surgery using a great omentum flap and skin graft are reported. The surgery was attempted only after numerous other treatments had failed. The technique is described and the advantages and disadvantages are evaluated. (JSR)

14534 CONSIDERATION ON SELECTIVE TISSUE ABSORPTION OF IONIZING RADIATION. Dubinin, I.; Chvojka, Z.; Pohlova, L. (Katedra Radiologie a Nuklearni Mediciny, Brno). Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.; 16: No. 2, 121-127(1973). (In Czech).

Calculation of distribution of absorbed radiation doses in heterogeneous absorption milieu and graphical representation of selective absorption using an isodose scheme are presented. Selective absorption is practically demonstrated on the example of irradiation of a tumorous focus situated in the hilus of the lung. The importance of absorbed radiation doses is pointed out both from the clinical point of view and the point of general radiobiology. (auth)

14535 CARCINOMA OF THE ORAL TONGUE AND FLOOR OF MOUTH: FIFTEEN YEARS' EXPERIENCE WITH LINEAR ACCELERATOR THERAPY. Gilbert, E. H.; Goffinet, D. R.; Bagshaw, M. A. (Stanford Univ., CA). Cancer; 35: No. 6, 1517-1524 (Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

One hundred fourteen patients with carcinomas of the oral tongue and floor of mouth were treated with high-dose megavoltage radiation at Stanford University from 1956 to 1970. Actuarial 5-year survival for 56 patients with oral tongue lesions was: T_1, 73 percent; T_2, 37 percent; and T_3, 19 percent. Similarly, for 58 patients with lesions of the floor of mouth, 5-year survival was: T_1, 73 percent; T_2, 37 percent; and T_3, 25 percent. Local control of the primary was obtained in oral tongue T_1 lesions 10 of 11 times; T_2, 5 of 8; and T_3, 13 of 36 times. For floor of mouth, local control was: T_1, 22 of 26; T_2, 7 of 14; and T_3, 3 of 15. There was an indication that better control was obtained if interstitial therapy was a planned part of the treatment. Dose for local control when external radiation alone was utilized was usually over 1900 rets. Patients with initially clinically negative nodes (T/sub x/N/sub O/) who had a low radiation dose to primary echelon lymph nodes developed later cervical lymph node metastases 38 percent of the time. In no case did late metastatic disease appear in patients whose necks were treated prophylactically. (auth)

14536 CARCINOMA OF THE ENDOLARYNX: RESULTS OF IRRADIATION. Fayos, J. V. (Univ. of Michigan, Ann Arbor). Cancer; 35: No. 6, 1525-1532(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Irradiation at the University of Michigan in the 1960's was carried out in 192 patients with endolaryngeal carcinoma. Thirty-two and 66 percent of the cases were located in the supraglottic and glottic regions respectively. Cases were classified in stages after appropriate TNM grouping. Results were analyzed with respect to tumor location, size, and dose-time relationship. Early lesions were controlled more often than advanced ones. Radical surgery to the primary and/or neck improved overall survival, which was 89 percent at 5 years for 127 glottic carcinoma cases and 61 percent for 61 patients with supraglottic tumors. No significant complications were found following radiation therapy. (auth)

14537 EVALUATION OF UNIVERSITY OF FLORIDA SPLIT-COURSE TECHNIQUE FOR VARIOUS HEAD AND NECK SQUAMOUS CELL CARNINOMAS. Million, R. R.; Zimmermann, R. C. (Univ. of Florida, Gainesville). Cancer; 35: No. 6, 1533-1536(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

A retrospective evaluation was made of 260 patients with squamous carcinoma of various head and neck sites in order to determine the relative value of continuous vs. split-course irradiation techniques. There was no obvious difference in local control or survival in early-stage cases. The continuous technique resulted in a better local control and survival rate in moderately advanced and advanced stages. Complications were less severe in the split-course cases. (auth)

14538 UNILATERAL HYPOGLOSSAL NERVE ATROPHY AS A LATE COMPLICATION OF RADIATION THERAPY OF HEAD AND NECK CARCINOMA: A REPORT OF FOUR CASES AND A REVIEW OF THE LITERATURE ON PERIPHERAL AND CRANIAL NERVE DAMAGES AFTER RADIATION THERAPY. Cheng, V. S. T.; Schulz, M. D. (Massachusetts General Hospital, Boston). Cancer; 35: No. 6, 1537-1544(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

The case histories of four patients who developed hemiatrophy of the tongue from 3 to 9 years after a course of curative radiation therapy for carcinomas of the head and neck are presented. These patients were subsequently followed for from $1\frac{1}{2}$ to 6 years without local recurrence of the tumor, distant metastasis, or involvement of other cranial nerves, indicative of only a unilateral hypoglossal nerve atrophy. A review of the literature showed that peripheral and cranial nerve damages after radiation therapy have been reported for the optic nerve, hypoglossal nerve, oculomotor nerve, abducens nerve, recurrent laryngeal nerve, brachial plexus nerves, and peripheral nerves of the extremities. Review of clinical and experimental data indicated that in most cases, the damages were probably caused by extensive connective tissue fibrosis around and infiltrating the nerve trunks. Three possible types of peripheral and cranial nerve damages after radiation therapy are identified. (auth)

14539 ROLE OF RADIATION THERAPY IN THE TREATMENT OF ASTROCYTOMAS. Leibel, S. A.; Sheline, G. E.; Wara, W. M.; Boldrey, E. B.; Nielsen, S. L. (Univ. of California, San Francisco). Cancer; 35: No. 6, 1551-1557(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

One hundred forty-seven patients with astrocytoma were treated between 1942 and 1967. There were 25 postoperative deaths. The 14 patients in whom the tumor was thought to have been completely removed were not irradiated and all survived 5 years or longer. Seventy-one of the 108 patients with incompletely excised lesions received radiation therapy. The 5-year survival rate for those with incomplete resection alone was 19 percent, compared to 46 percent when irradiation was given. Based on observations up to 20 years, after incomplete removal postoperative irradiation significantly prolonged useful life and may have lead to permanent control in some. There was no evidence of radiation damage. Most of these tumors were fibrillary astrocytomas, and the results apply particularly to this histologic type. Only 1 of 11 patients with gemistocytic astrocytoma survived 5 years. The survival rate for Grade I tumors was appreciably greater than for Grade II lesions; in both grades, it was improved by irradiation. (auth)

14540 RADIATION TOLERANCE OF THE SPINAL CORD. Wara, W. M.; Phillips, T. L.; Sheline, G. E.; Schwade, G. C. (Univ. of California, San Francisco). Cancer; 35: No. 6, 1558-1562(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

A series of nine cases of radiation myelopathy seen at the University of California, San Francisco (UCSF) is reviewed, and their treatment data converted into nominal single doses (NSD) and equivalent single doses (ED). The 1 percent incidence level of myelopathy in the thoracic cord is 1015 rets (ED), and the 50 percent incidence level is 1476 rets (ED). Caution should be used when utilizing a rapid fractionation schedule; it appears that 2000 rads in 5 fractions and 3000 rads in 10 fractions is a safe regimen for the thoracic spinal cord. (auth)

14541 IMPROVED SURVIVAL OF PATIENTS WITH INTRACRANIAL EPENDYMOMAS BY IRRADIATION: DOSE SELECTION AND FIELD EXTENSION. Salazar, O. M.; Rubin, P.; Bassano, D.; Marcial, V. A. (Univ. of Rochester, NY). Cancer; 35: No. 6, 1563-1573(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Intracranial ependymomas, treated with postoperative irradiation, have a 50 percent 5-year survival. Although this rate is good, the issue remains whether the quantity and quality of survival can be improved by the proper selection of treatment factors, i.e., field size and dose-time relationship. Factors influencing survival and the effect of dose and field selection are considered in 28 intracranial ependymomas. Nineteen spinal primaries are also presented for comparison. Only 10 percent of the patients treated with doses below 1350 rets are alive, vs. 56 percent of the patients treated with higher doses. Only 21 percent of the patients treated with partial brain irradiation survived, vs. 57 percent of those treated with whole brain irradiation. Although an apparent 5-year survival difference was found for the low-

grade (63 percent) vs. high grade (13 percent) tumors, high-dose whole brain irradiation had a significant effect only on the survival of the high-grade tumors. Local recurrences accounted for the majority of therapeutic failures. Ten consecutive patients were treated with elective craniospinal irradiation and exhibited a 3-year survival of 70 percent, vs. 35 percent in those treated conventionally to the brain only. Elective craniospinal irradiation, advocated for the high-grade, particularly infratentorial, ependymomas, has currently yielded higher survival, lower recurrences, good tolerance, no complications, and excellent quality of survival. Further documentation of this treatment approach is suggested. (auth)

14542 TREATMENT OF CHROMOPHOBE ADENOMAS WITH MEGAVOLTAGE IRRADIATION. Pistenma, D. A.; Goffinet, D. R.; Bagshaw, M. A.; Hanbery, J. W.; Eltringham, J. R. (Stanford Univ., CA). Cancer; 35: No. 6, 1574-1582(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

From 1956 to 1972, 62 previously untreated patients with chromophobe adenomas received high-dose (average equivalent dose: 5700 rads in 6 weeks) megavoltage (4 to 4.8 MeV) irradiation at Stanford, 33 postoperatively and 29 as the only intended treatment. Initial treatment failure rates were 18 percent and 41 percent, respectively; however, overall control was 85 percent and 90 percent, despite 2 uncontrolled invasive adenomas in each group. Nine of the 12 failures in the group treated by irradiation alone had cystic tumors, and 9 of the 12 failed in less than 3 months. Despite a considerably greater degree of abnormal vision initially in the postoperative irradiation group, improvement of vision with treatment in that group was 83 percent (39 percent returned to normal) compared to 46 percent (only 8 percent to normal) in the irradiation alone group. Based upon an evaluation of the extent of findings at diagnosis and our results, we recommend surgical decompression followed by 5000 rads in 5 weeks for patients with any one or more of the following findings: (1) more than minimal depression of peripheral visual fields; (2) corrected visual actuity of less than 20/30 in either eye; or (3) more than 1-cm suprasellar extension of tumor. (auth)

14543 INFLUENCE OF DOSE FRACTIONATION ON ACUTE AND LATE REACTIONS IN PATIENTS WITH POSTOPERATIVE RADIOTHERAPY FOR CARCINOMA OF THE BREAST. Kim, J. H.; Chu, F. C. H.; Hilaris, B. (Sloan-Kettering Cancer Center, New York). Cancer; 35: No. 6, 1583-1586(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

The clinical courses of 418 patients with breast carcinoma who received post-radical-mastectomy radiation therapy to the internal mammary and supraclavicular area were reviewed in order to determine the normal tissue tolerance with various time-dose fractionation radiation regimens. Four different dose fractionation schedules were employed during the period 1958–1968 at Memorial Hospital: 4900 rads/10f/32d; 4410 rads/9f/30d; 5000 rads/13f/18d; and 4600 rads/20f/28d. There was no difference in the acute reaction or local recurrence rate of the tumor in the irradiated area among the four fractionation schemes, but the late effects were quite different. Patients who received 4900 rads in 10 fractions in 32 days had a 33 percent incidence of subcutaneous fibrosis. A similar dose in 13 fractions in 21/2 to 3 weeks resulted in about 17 percent subcutaneous fibrosis. No significant late effects were observed in the patients who received either 4600 rads in 20 fractions or 4410 rads in 9 fractions in 4 weeks. The significance of these clinical findings is discussed in relation to the various formulae currently being used to express time-dose equivalence. (auth)

14544 RADIATION THERAPY AS PRIMARY TREATMENT FOR EARLY STAGE CARCINOMA OF THE BREAST. Prosnitz, L. R.; Goldenberg, I. S. (Yale Univ., New Haven). Cancer; 35: No. 6, 1587-1596(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

A treatment program for early stage breast cancer consisting of biopsy only and primary radiation therapy is described. The treatment plan is radical with tumoricidal doses or radiation delivered to the breast and axiallary, supraclavicular, and internal mammary lymph nodes, i.e., 6000 to 7000 rads to clinically involved areas and 4500 to 5000 rads to subclinical disease. Thirty patients have been treated with this program, with followup ranging from 1 to 10 years. Only 1 patient has died from her disease; 1 has had a local recurrence readily controlled with mastectomy. Twenty-six patients are alive and well; there have been 3 deaths from intercurrent illness. No significant radiation complications have occurred. Radiation therapy as the sole treatment for breast cancer has been described in the literature for at least 20 years but generally ignored by clinicians. It deserves evaluation as a treatment option in randomized therapeutic trails. (auth)

14545 PREOPERATIVE IRRADIATION FOR CARCINOMA OF THE RECTUM AND RECTOSIGMOID COLON: REPORT OF A NATIONAL VETERANS ADMINISTRATION RANDOMIZED STUDY. Roswit, B. (Veterans Administration Hospital, Bronx, NY); Higgins, G. A.; Keehn, R. J. Cancer; 35: No. 6, 1597-1602(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

In 1964 the Veterans Administration Surgical Adjuvant Group (VASAG) initiated a large-scale, controlled, randomized protocol to study the role of low-dose preoperative irradiation (2000 to 2500 rads/10 fractions/12 days) in patients with operable adenocarcinoma of the sigmoid colon and rectum. This report analyzes the data in 700 patients, all at 5-year risk. There appears to be a definite benefit to irradiated patients who undergo abdominoperineal resections, when compared with the controls. This advantage is reflected in improvement of 5-year survival, and reductions in lymph node invasion, local recurrence, and distant metastases. A second protocol has been initiated in 30 VA hospitals employing a higher dose (3150 rads) to extended portals (to L2) to male patients who require abdominoperineal resections. (auth)

14546 BIOLOGICAL EFFECTS EVALUATED AS A FUNCTION OF PATIENT THICKNESS, BEAM QUALITY, SSD, AND TREATMENTS SCHEDULE. Bhatnagar, J. P.; Feldman, M. I.; Spira, J. (Boston Univ.). Cancer; 35: No. 6, 1606-1615(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Continuing efforts are being made by clinical radiotherapists to evaluate radiation complications to normal tissue and organs by specific time-dose parameters. Currently, the NSD concept of Ellis is receiving wide application in the literature in the reporting of radiation complications and normal tissue tolerances. To afford an easy and broad application of the NSD concept to the evaluation of physiological, functional, or structural changes, the authors have evolved mathematical expressions for the calculations of NSD as a function of patient thickness, beam energy, SSD, and treatment schedule involving coplanar field arrangements whether the fields are treated alternately or simultaneously. Several interesting aspects evolving from the concepts of treatment planning in terms of the NSD or biological effects indicate that: for beam energies above 22 MeV, treatment is more ideally performed by treating only one field per day, since the depth of electronic equilibrium provides more effective sparing of superficial organs and tissues; large-field therapy, such as the total nodal irradiation of Hodgkins's disease, can be more effectively treated in terms of tissue sparing by higher energy beams than cobalt-60 or 4-MeV for practically all patient dimensions; a new concept of integral biological dose, the "gram-ret," is proposed, which represents the quantitation of total biological effect; a series of tables with multiplication factors programmed on a digital computer is presented, which very quickly make available the NSD in any fractionated radiation treatment cycle to any plane of the body as a function of the beam energy, SSD, patient thickness, and continuous or split-course therapy schedule. (auth)

14547 EFFECT OF RADICAL RADIOTHERAPY ON DELAYED HYPERSENSITIVITY AND THE INFLAMMATORY RESPONSE. Ghossein, N. A.; Bosworth, J. L.; Bases, R. E. (Yeshiva Univ., Bronx, NY). Cancer; 35: No. 6, 1616-1620(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Delayed hypersensitivity to DNCB and the inflammatory response to croton oil were evaluated in 144 and 121 patients, respectively, prior to and 3 to 6 months following curative radiotherapy. Eighty-one patients had in vitro lymphocyte transformation by PHA; 59 (41 percent) were nonreactors to DNCB and 26 (22 percent) to croton oil; 29 of 59 (49 percent) initially anergic to DNCB became reactive following radiotherapy. Only 13 of 85 (15 percent) initially reactive became anergic. Similar improvement of the inflammatory response was obtained. Patients who became DNCB-reactive following radiotherapy had the same favorable prognosis as those who were initially reactive. Radiotherapy did not adversely affect either delayed hypersensitivity or the inflammatory response. There was a 50 percent decrease in PHA stimulation and lymphocyte count after treatment. No correlation was found between DNCB reactivity and lymphocyte transformation prior to or following radiotherapy. The evaluation of the effect of radiotherapy on cell-mediated immunity depends on the tests used. (auth)

14548 ROLE OF SPLENIC IRRADIATION IN CHRONIC LYMPHOCYTIC LEUKEMIA. Byhardt, R. W.; Brace, K. C.; Wiernik, P. H. (National Cancer Inst., Baltimore). Cancer; 35: No. 6, 1621-1625(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Fourteen patients with chronic lymphocytic leukemia (CLL) who received a total of 23 courses of splenic irradiation (SI) for various

combinations of painful splenomegaly, progressive leukocytosis, lymphocytosis, thrombocytopenia, and anemia are reviewed. Splenic midplane doses ranged from 200 to 1750 rads (3 to 14 days), while the most typical regimen was 300 to 450 rads in two to three fractions of 150 rads given over 3 to 8 days. Response to SI was rated according to a scoring system which evaluated the splenic and hematologic response, as well as the response of disease-related symptoms. According to this scoring system, most patients demonstrated a significant relief of painful splenomegaly, along with improvement of hemogram and bone marrow parameters. While those patients judged as failures to prior chemotherapy or total body irradiation showed improvement following SI, those who had received minimal therapy prior to SI showed a superior response. SI, in those showing a satisfactory response, was repeated successfully in several patients (up to six times in one instance). The onset and duration of response to SI, dose-response data, survival, clinical and hematologic responses, and the possible mechanisms of action of SI are discussed with reference to the available literature. (auth)

14549 MEASURES TO MINIMIZE SMALL INTESTINE INJURY IN THE IRRADIATED PELVIS. Green, N.; Iba, G.; Smith, W. R. (Hospital of the Good Samaritan, Los Angeles). Cancer; 35: No. 6, 1633-1640(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Small intestine injury causes long-term suffering and high mortality. Five of 187 of our patients had developed serious small intestine injury. Four patients had corrective surgery. Three patients died. All were women. Subsequently, all patients who received definitive pelvic irradiation had small intestine roentgenograms to determine its location and mobility. Female patients, thin patients, and elderly patients had larger amounts of small intestine in the whole pelvis, a deeper cul de sac, and a greater incidence of relatively immobile small intestine. Patients with relatively immobile small intestine in the treatment field may be predisposed to injury. There was no relationship of the incidence of relatively immobile small intestine to prior pelvic surgery. We used the findings from the small intestine roentgenograms to modify individually the radiotherapy regimen so as to minimize the risk for small intestine injury. Patients were placed in the prone position to displace the small intestine out of the treatment fields used for booster dose irradiation. The treatment field was modified to exclude the small intestine. The total tumor dose delivered was determined by expectations for cure vs complications. To date, none of the patients in this study group has developed small intestine injury. Cadaver studies showed the feasibility of elective shortening of the pelvic cul de sac. The small intestine can be displayed away from the bladder, prostate, or cervix. (auth)

14550 RISK OF TUMOR INDUCTION IN MAN FOLLOWING MEDICAL IRRADIATION FOR MALIGNANT NEOPLASM. Seydel, H. G. (Fox Chase Cancer Center, Philadelphia). Cancer; 35: No. 6, 1641-1645(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

A review of second malignant tumors (S.M.T.s) following therapeutic irradiation for malignant neoplasm in man is presented. Twenty-one new cases are added to the literature, 3 of adenocarcinoma of the endometrium following treatment for squamous cell carcinoma of the cervix, 3 of adenocarcinoma of the large bowel following treatment for squamous cell carcinoma of the cervix, 9 S.M.T.s in irradiated oropharyngeal or oral mucosa, and 6 single cases of S.M.T.s following radiotherapy of cancers in other sites. It is suggested that there is relatively low incidence of S.M.T.s among patients for malignancy, but the risk remains to be established by an appropriate study of control and test populations. (auth)

14551 EXPLORATORY STUDY OF PROTON RADIATION THERAPY USING LARGE FIELD TECHNIQUES AND FRACTIONATED DOSE SCHEDULES. Suit, H. D. (Harvard Medical School, Boston); Goitein, M.; Tepper, J.; Koehler, A. M.; Schmidt, R. A.; Schneider, R. Cancer; 35: No. 6, 1646-1657(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Three patients were treated with 160-MeV protons combined with high-energy photons to examine the advantages and difficulties associated with the clinical implementation of a program of large-field, fractionated-dose, proton-radiation therapy. We found it necessary to: obtain an accurate three-dimensional determination of the treatment volume including the density of all tissues in the beam path; construct an adequate bolus to compensate for tissue heterogeneities; use much more precise and accurate immobilization and patient positioning devices than used in photon irradiation; treat with both protons and photons so as to keep the skin dose within an acceptable level. In tissues without significant inhomogeneities due to bone and air space we have delivered a well-defined dose to involved tissues while sparing distal sensitive structures. However, in those regions where there is much fine structure of tissue density, it has been difficult to compensate satisfactorily for the inhomogeneities. (auth)

Vertebrates

Refer also to abstracts 14439 and 14453.

14552 (JPRS-64929, pp 51-58) PECULIARITIES OF ENERGY METABOLISM IN THE CENTRAL NERVOUS SYSTEM UNDER THE COMBINED INFLUENCE OF VIBRATION AND IRRADIATION. Luk'yanova, L. D. 2 Jan 1973. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 9: No. 2, 32-37(Mar 1975).

In Space Biology and Aerospace Medicine.

Vibrations (70 Hz, 0.4 mm) were shown to bring about cyclic changes in functioning of the respiratory chain in brain tissue of rats. Short-term (five-minute) excitation may stimulate the respiratory function, whereas a longer (15-minute) exposure may weaken the energy control. Oxidative processes in the central nervous system and post-vibration inhibition of higher cerebral compartments were found to determine the development of radiation sickness in response to the combined effect of vibration and radiation. (auth)

14553 (N-74-33533) BIOLOGICAL RESEARCH IN SPACE: SOME CONCLUSIONS AND PROSPECTS. Gazenko, O. G.; Ilin, E. A.; Parfenov, G. P. Translated from Izv. Akad. Nauk SSSR, Ser. Biol.; No. 4, 461-475(1974). 29p. (NASA-TT-F-15961). NTIS $4.50.

The main Soviet biomedical experiments conducted since the beginning of space flight are reviewed; on the basis of their results, it is concluded that prolonged manned space flight is possible, although certain apparently reversible changes in vital processes have been noted. The experiments are divided into four groups: research on mammals and turtles, on insects and amphibians, on plants, and on microorganisms and tissue cultures. In these experiments, the genetic effect of cosmic ionizing radiation and other factors of space environment, and the effect of weightlessness are stressed. (auth)

14554 (UCRL-Trans-10720) CHARACTERISTICS OF RADIATION DAMAGE TO BRAIN DNA AND DNP. Kakuliya, M. E. Translated from Vopr. Biokhim. Nervn. Myshechnoi Sist.; No. 2, 89-100(1972). 24p. Dep. NTIS $4.25.

The brain of the rabbit embryo was found to be exceptionally sensitive to the action of x rays. In damage to the DNA of the embryonic brain, the change of the nucleotide composition of DNA, in addition to the direct action of radiation, a considerable part is apparently played by DNA depolymerases released by ionizing radiation from the cell organelles. The DNA and DNP of the adult animal brain are also damaged by ionizing radiation, but contrast to the case of the embryonic brain, the macromolecular structure of the brain DNA of the adult animal is restored. The harmful processes and the postradiation repair of the DNA are expressed more strongly in the gray matter of the brain than in the white. Metabolic processes and hormonal reactions take part in the radiation damage of the brain DNP in the adult animal. (auth)

14555 GLUCOCORTICOID-BINDING COMPONENTS IN AN IRRADIATION-INDUCED THYMOMA OF THE C57BL/6J MOUSE. Leinen, J. G.; Wittliff, J. L.; Kostyu, J. A.; Brown, R. C. (Univ. of Rochester Cancer Center, NY). Cancer Res.; 34: No. 10, 2779-2783(Oct 1974).

Preliminary experiments on thymocyte suspensions derived from normal thymus and gamma-irradiation-induced thymomas of the C57BL/6J mouse indicated the presence of macromolecular species capable of binding triamcinolone acetonide-^{3}H specifically with high affinity. Retention of labeled steroid by isolated tumor cells varied considerably among thymomas. Using cell-free preparations and a dextran-coated charcoal procedure, tumor cytosols bound triamcinolone acetonide-^{3}H with a dissociation constant of 3×10^{-9} M; the number of binding sites was 354 fmoles/mg cytosol protein. Cytosols contained binding components that sedimented at 7 to 8 S on low-salt gradients and at 4 to 5 S on gradients containing 0.4 M KCl. These cytoplasmic components bound principally hormones with glucocorticoid activity as indicated by the competition of triamcinolone acetonide-^{3}H binding in the presence of 5×10^{-8} M cortisol, dexamethasone, and cortexolone as well as by progesterone and aldosterone. Neither estradiol-17beta, estriol, testosterone, nor dihydrotestosterone at 5×10^{-8} M inhibited specific binding of triamcinolone acetonide-^{3}H. Generally, the binding properties of isolated thymocytes were similar to those determined on cell-free preparations. (auth)

14556 EFFECT OF IRRADIATION ON THE THYROID CELL PROLIFERATION IN RATS. Christov, K. (Univ., Freiburg i. B.). pp 40-45 of Characterization of Human Tumours. Maltoni, C. (ed.). Amsterdam; Excerpta Medica (1974).

From fifth international symposium on the biological characterization of human tumours; Bologna, Italy (4 Apr 1973).

Information is given on the extent to which weight changes in the thyroid gland, induced by irradiation and by treatment of rats with methylthiouracil, are associated with changes in the number of dividing cells and DNA synthesis. Tritiated thymidine was used as a tracer for cell dividing activity. (NL)

14557 EFFECT OF BETA RADIATION ON THE REGENERATION OF INTERRUPTED CORNEAL NERVES. I. Vital Staining With Methylene Blue. Simkova, M. (Karlova Univ., Prague). Sb. Lek.; 76: No. 2, 39-44(1974). (In Russian).

In experiments on rabbits, the author performed in four groups in the upper third of the circumference of the limbus subtotal keratotomy and the middle portion of the section was irradiated on the 5th day with doses of 2500, 5000, 7500, and 10,000 rad (at individual sessions of 2500 rad) by means of a contact beta emitter. Readings of the results of vital staining with methylene blue were taken on the 5th, 7th, 9th, 14th, 18th, 21st, 25th, and 28th day after termination of irradiation. It was revealed that degeneration of the severed corneal nerves is hastened markedly only by a dose of 10,000 rad. Regeneration in the limbal strip and retrograde collateral reinnervation is hastened also only by this dose but not markedly. The authors found, however, a marked difference in the rate of nerve penetration through the irradiated and not irradiated portion of the scar. In the irradiated portion the penetration is faster by 3 days when 2500 rad are administered, by 7 days after 5000 rad, by 10 days after 7500 rad and 11 to 14 days after 10,000 rad. Also an increase of the total dose enhances the reinnervation through the affected area of the scar and the difference between different groups is 3 to 4 days. (auth)

14558 HISTOPATHOLOGICAL FINDINGS IN MICE AFTER REPEATED ^{224}Ra ADMINISTRATION. Julisova, D.; Dvorak, V. (Inst. of Hygiene and Epidemiology, Prague). pp 139-144 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

After repeated intraperitoneal administration of ^{224}Ra causing the skeletal dose corresponding with the dose resulting from a single injection of 30 uCi of ^{224}Ra/kg, osteosarcomas in 43% and spleen atrophy in 11% of the experimental mice were observed. No such findings were proved in non-active mice. A rather broad spectrum of other malignant or benign mice were found. Earlier occurrence of hemoblastosis in experimental animals was observed. Carcinomas, sarcomas, benign tumors, and primary amyloidosis found frequently in controls may be associated with the strain of mice or with their age. (auth)

14559 DOSE-RELATIONSHIP FOR TRANSLOCATIONS INDUCED BY X IRRADIATION IN MOUSE OOCYTES. Gilliavod, N.; Leonard, A. (CEN/SCK, Mol, Belgium). Mutat. Res.; 26: No. 3, 425-426(Dec 1974).

14560 CHANGES AT TRANSCRIPTIONAL LEVEL IN THE RAT LIVER FOLLOWING WHOLE-BODY X IRRADIATION. Subba, Rao, M. N.; Netrawali, M. S.; Pradhan, D. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 48: No. 1, 160-163(1 Nov 1974).

Evidence is presented that concurrent with amplification in template capacity of liver chromatin, incorporation of labelled amino acid precursors into specific chromosomal acidic proteins in the liver is also selectively stimulated during 4 to 24 hr following whole-body exposure of rats to 1000 R x rays. (NL)

14561 CHROMOSOMAL REARRANGEMENTS INDUCED IN MOUSE SPERMATOGONIA BY 14.5-MeV NEUTRONS. Valentin, K. (Univ. of Stockholm). Mutat. Res.; 27: No. 2, 261-270 (Feb 1975).

Inbred CBA male mice were irradiated with 14.5-MeV neutrons. Three acute doses and one chronic dose were given. The percentages of affected spermatocytes as counted from reciprocal translocations induced in spermatogonia were determined for the acute series and for the chronic exposure. The data could be fitted to a linear or concave curvilinear regression line. There seemed to be a slight increase of damage with dose; the existence of dose-rate effects is discussed. (NL)

14562 CELLULAR STUDIES OF X-RAY INDUCED INHIBITION OF LENS REGENERATION. Michel, C.; Yamada, T. (Oak Ridge National Lab., TN). Differentiation; 2: 193-201(1974).

Whole-body x-irradiation of adult newts 0 to 3 days after lentectomy inhibits transformation of the dorsal iris epithelium into a lens in all cases. The first question raised was whether irradiation affects infiltration of the iris area by macrophages, and the phagocytic activities of these cell types in the iris epithelium (prominent phenomena in this system). The number of macrophages infiltrating into the iris epithelium, and their phagocytic activities (indicated by uptake of melanosomes) were not affected by irradiation under those conditions. The second group of experiments concerns the possible effects of irradiation on DNA replication of iris epithelial cells, which become transformed into lens cells in the non-irradiated system. Autoradiographic studies of iris epithelial cells in vivo revealed a significant suppressive effect of irradiation on the frequencies of cells incorporating ^{3}H-thymidine 7 and 14 days after lentectomy. When autoradiography was applied to the primary pure culture of iris epithelial cells at different time intervals after the start of culture and irradiation in vitro, significant and persistent reduction of cell labelling due to irradiation was demonstrated. Multiplication of spread cells in the iris epithelial culture was strongly and persistently inhibited throughout a period of 2 months. Inhibition of cell labelling and of cell multiplication was always accompanied by reduction in the extent of de-pigmentation of iris epithelial cells. Depigmentation is one of the requirements for the cells become transformed into lens cells. The possible mechanism of radiation-induced inhibition of lens regeneration is discussed. (auth)

14563 VETERINARY NUCLEAR MEDICINE. Kalifelz, F. A.; Comar, C. L.; Wentworth, R. A. (Cornell Univ., Ithaca, NY). Adv. Vet. Sci. Comp. Med; 18: 55-78(1974).

A brief review is presented of the expanding horizons of nuclear medicine, the equipment necessary for a nuclear medicine laboratory is listed, and the value of this relatively new field to the veterinary clinician is indicated. Although clinical applications to veterinary medicine have not kept pace with those of human medicine, many advances have been made, particularly in the use of in vitro techniques. Areas for expanded applications should include competitive protein binding and other in vitro procedures, particularly in connection with metabolic profile studies. Indicated also is more intensive application by the veterinarian of imaging procedures, which have been found to be of such great value to the physician. (auth)

14564 TUMOR MICROVASCULATURE FOLLOWING FRACTIONATED X IRRADIATION. Hilmas, D. E.; Gillette, E. L. (Colorado State Univ., Fort Collins). Radiology; 116: No. 1, 165-169(Jul 1975).

From 5th international Congress of Radiation Research; Seattle, WA (14 Jul 1974).

The microvasculature of C_3H/Bi mouse mammary carcinomas 8 mm in average diameter was evaluated using morphometric methods following six consecutive daily exposures of 500 R of x radiation. Tumor volume did not change significantly during the intervals between treatments. Tumors began to grow again 72 hours after the sixth 500-R fraction, with mean vessel length and surface area reaching maximum values and vessel diameters and volumes becoming minimal at this time. These changes were attributed to improved colloidal-carbon filling of previously existing nonfunctional vessels. When anatomically derived estimates of vascular dimensions were related to a metabolically useful blood supply, improved capability for exchange of essential nutrients occurred 72 hours after the sixth 500-R fraction. (auth)

14565 DAMAGE TO MOUSE LUNG WITH FRACTIONATED NEUTRONS AND X RAYS. Hornsey, S.; Kutsutani, Y.; Field, S. B. (Hammersmith Hospital, London). Radiology; 116: No. 1, 171-174(Jul 1975).

The relative biological effectiveness (RBE) for damage to mouse lung was measured for single doses and up to 30 fractions of 8 MV x rays and fast neutrons, relative to 250 kVp x rays. With 8 MV x rays the RBE was 0.87 and did not vary with dose per fraction between 150 and 1200 rad. With fast neutrons the RBE did vary from 1.5 at 1200 rad of x rays, which is about 30 percent lower than that for skin, to 3.7 at 150 rad of x rays, which is about 10 percent less than that for skin. The implications for treatment of the lung with fast neutrons are discussed. (auth)

14566 ENDOTHELIAL REPAIR OF RADIATION DAMAGE FOLLOWING BETA IRRADIATION. Gillette, E. L.; Maurer, G. D.; Severin, G. A. (Colorado State Univ., Fort Collins). Radiology; 116: No. 1, 175-177(Jul 1975).

Lamellar keratectomy was performed in dogs to induce capillary endothelial proliferation at the limbus of the eye and the radiation response of endothelial cells was evaluated in terms of the dose required to prevent neovascularization in 50 percent of irradiated eyes (NVD_{50}). Single- and split-dose experiments were carried out before and after induction of proliferation to determine the response of slowly and rapidly proliferating endothelial cells.

The NVD_{50}s prior to induction were about 400 rads greater than those following induction, indicating increased resistance of slowly proliferating cells. Split-dose studies indicated that the radiation repair capability was about 350 rads, either before or after induction. (auth)

14567 YIELD OF CHROMOSOMAL ABERRATIONS IN RABBIT LYMPHOCYTES AFTER IRRADIATION IN VITRO AND IN VIVO. Bajerska, A.; Liniecki, J. (Inst. of Occupational Medicine, Lodz, Poland). Mutat. Res.; 27: No. 2, 271-284 (Feb 1975).

The culture time of rabbit lymphocytes (41-42 h) that provides cells in their first post-stimulation mitosis, was estimated on the basis of the mitotic index, dicentric yield, and presence of the cells with these aberrations unaccompanied by acentric fragments, studied as a function of culture duration. The cells obtained in metaphase from cultures terminated at this time displayed no donor-to-donor variation where induction of dicentrics by x rays was concerned. Rabbit venous blood was irradiated in vitro with a range of x and gamma doses, and dose-effect curves were obtained by regression analysis. Sixteen rabbits were irradiated in vivo (uniform whole-body irradiation), and blood was sampled at different intervals after exposure. The frequency of dicentrics in the lymphocytes cultured did not change significantly over the first 24 h after irradiation. Dose-effect relationships in vivo fell within one standard error confidence limits of the respective curves in vitro. It was concluded that the latter may be used for estimation of dose in vivo under conditions of homogeneous whole-body irradiation. (NL)

14568 RADIOSENSITIVITY OF T AND B LYMPHOCYTES. III. Effect of Radiation on Immunoglobulin Production by B Cells. Anderson, R. E.; Warner, N. L. (Univ. of New Mexico, Albuquerque). J. Immunol.; 115: No. 1, 161-169(Jul 1975).

Radiation injury in defined populations of B cells was investigated utilizing an allotype congenic transfer system. The amount of donor immunoglobulin present in the recipient's serum was found to be directly proportional to the number of viable cells injected, and on this basis approximate D_{37} values for the inoculated B cells were determined in several experiments and found to fall in the 70 to 145 rad range depending upon the specific experimental conditions. Since the sensitivity of T cells to radiation-induced interphase death can be modified by prior exposure to select mitogens and antigens, an attempt was made to demonstrate a similar phenomenon with respect to B cells. The results indicate that the radiosensitivity of B cells can be slightly influenced by prior incubation with mitogens and only equivocally changed by activation with antigen. (auth)

14569 FINE STRUCTURAL STUDY ON THE RESPONSE OF THE CEREBELLAR CORTEX TO ACUTE RADIATION INJURY. De Estable-Puig, R. F.; Estable-Puig, J. F. (Laval Univ., Quebec). Exp. Pathol.; 9: No. 4, 231-246(1974).

Ultrastructural studies of the rat cerebellar cortex subjected to a single high dose of x or gamma rays reveal the presence of early cytoplasmic changes in all neurons (mitochondrial alterations, dilatations and/or increase of the vacuolar and membranous compartments, abundant dense bodies and plasma membrane differentiations). In the granules, these alterations in addition to striking nuclear changes lead to acute cell necrosis. In the large neurons, on the contrary, the changes seem to be transient. Glial reaction, edema, alterations of cortical myelin fibers and synaptic degeneration are reported. (auth)

14570 EFFECT OF BONE MARROW AUTOGRAFTS ON POSTRADIATION RECOVERY OF THE INTESTINE. Fedorovskii, L. L. (Inst. of Biophysics, Moscow). Bull. Exp. Biol. Med. (USSR) (Engl. Transl.); 77: No. 2, 122-124(Feb 1974).

Translated from Byull. Eksp. Biol. Med.; 77: No. 2, 28-31 (Feb 1974).

After uneven irradiation of rats (of the intestine in a dose of 1,050 R and the rest of the body in a dose of 735 R), leading to 100% mortality among the animals in the course of 3.5-5 days, bone marrow autografts speeded up recovery of the DNA content in the mucous membrane and weakened the inhibition of the enzyme-secreting function of the intestine. Many (40%) of the irradiated rats with bone marrow autografts survived up to the 30th day of observation. (auth)

14571 ALTERED SENSITIVITY OF HEMATOPOIETIC STEM CELLS TO 5-FLUOROURACIL (NSC-19893) FOLLOWING ENDOTOXIN (NSC-189681), CYCLOPHOSPHAMIDE (NSC-26271), OR IRRADIATION. Eaves, A. C.; Bruce, W. R. (Ontario Cancer Inst., Toronto). Cancer Chemother. Rep.; 58: No. 6, 813-820 (1974).

Hematopoietic cells that form colonies in the spleen (CFU-S) or in culture (CFU-C) from the marrow of endotoxin-treated mice become markedly sensitive to a 6-hour in vivo exposure to 2.5 mg of 5-fluorouracil (5-FU). It was therefore suggested that short exposures to 5-FU (2.5 mg given 6 hours before the animals were killed) could be used to follow changes in the sensitivity of CFU-S and CFU-C after several treatments which might stimulate the proliferation of marrow colony-forming cells. After 25 mu g of endotoxin was given, a maximum reduction (approximately 100-fold) in the number of colony-forming cells in 5-FU-treated mice occurred at 36 hours, with recovery to starting values by 72 hours. Similar changes in sensitivity to 5-FU were also seen in mice whose marrows were undergoing hematopoietic regeneration after 3 mg of cyclophosphamide or 150 rads of total-body irradiation. These results indicate that agents which perturb the marrow may be quantitatively examined on the basis of their ability to alter the sensitivity of hematopoietic progenitor cells to chemotherapeutic agents. (auth)

14572 CHANGED ACTIVITIES OF BRAIN ENZYMES INVOLVED IN NEUROTRANSMITTER METABOLISM IN RATS EXPOSED TO DIFFERENT QUALITIES OF IONIZING RADIATION. Catravas, G. N.; McHale, C. G. (Armed Forces Radiobiology Research Inst., Bethesda, MD). J. Neurochem.; 24: No. 4, 673-676(Apr 1975).

The effect of different qualities of ionizing radiation on the activity of brain enzymes involved in the metabolism of neurotransmitters in specific regions of the brain of rats was investigated. Groups of Sprague-Dawley adult male rats were exposed to approx. 18,000 rads of radiation either rich in neutrons or rich in γ rays. It was found that, when the animals were exposed to radiation rich in neutrons, monoamine oxidase (MAO) activity was markedly decreased in all brain areas studied. In contrast, a very marked increase in the activity of this enzyme was observed when the animals received the same dose of radiation rich in γ rays. Relatively minor changes were observed in the activity of choline acetyl transferase (ChAc). Acetylcholinesterase (AChE) activity did not change appreciably. (auth)

14573 REGENERATION PROCESSES IN CHICK OVARY AFTER X-RAY IRRADIATION. Anastassova-Krusteva, M. N.; Bradinska, A. S.; Kuncheva, L. S. (Inst. of Morphology, Sofia). Compt. Rend. Acad. Bulg. Sci.; 28: No. 1, 133-136(1975).

The changes taking place in the post-natal chick ovary after doses injuring the sex cells were surveyed. Studies were made to determine the cellular elements in the adult ovary from which their regeneration occurs. In the ovaries of x-irradiated chicks, it was possible to observe a growth of the germinative epithelium and the appearance of ovocyte nests containing young meiotic forms. Taking part in the process of restoration are elements of both the embryonal epithelium and of the medullar connective tissue. (MCG)

14574 EXPERIMENTAL STUDY ON THE SIGNIFICANCE OF THE BONE MARROW LYMPHOCYTE IN HAEMATOPOIETIC REGENERATION FOLLOWING ACUTE INJURY DUE TO ^{60}Co IRRADIATION AND CYTOTOXIC DRUGS. Tange, T. (Tokyo Univ.). Acta Pathol. Jap.; 24: No. 1, 93-117(Jan 1974).

Hematopoietic cells of the rat bone marrow were killed almost completely by exposure to hydroxyurea (OHU), cytosine arabinoside (ara-C), ^{60}Co irradiation, and busulfan. The relation between the regeneration of 700 R whole body hematopoietic cells of the bone marrow and the behavior of the bone marrow lymphocytes and related cells was investigated quantitatively. Bone marrow lymphocytes and related cells were cytologically classified into lymphocytes, transitional cells and blastic cells on the smeared preparation. Comparing the results of the experiment using OHU 2.5 g/kg with those using whole-body irradiation of ^{60}Co 700R, the absolute number of nucleate cells in the bone marrow was reduced more prominently in the former case than in the latter. Nevertheless, regeneration of hematopoietic cells began earlier in the former case than in the latter. It was concluded that regeneration of bone marrow hematopoiesis can take place earlier and more rapidly, when the bone marrow lymphocytes are provided in sufficient numbers. (auth)

14575 STUDIES ON ANTIHISTAMINICS IN ACUTE RADIATION BURN. Dutt, N. R. J. Indian Med. Assoc.; 62: No. 1, 1-9(1 Jan 1974).

The effects of antihistamine drugs on recovery from radiation injury were studied. Histological sections of tissues of swine exposed to 600 R whole-body x radiation revealed marked atrophy of bone marrow. There was a reduction in the number of germinal centres in the spleen and lymph glands, and some showed necrotic or hemorrhagic areas. The animals receiving 800 R exhibited profound atrophy of bone marrow. Animals died as a result of the typical sequela of acute radiation syndrome. In the control group there was a rapid and sustained fall of the whole blood and serum histamine. In the treated animals the fall was less marked and recovery was more rapid. Similar findings were observed in the number of white blood cells. Morbidity was less marked in the

antazoline hydrochloride treated group. Mortality was 30 per cent in the controls. It may be possible that in addition to their action on histamine, antihistaminics possess other effects on various processes of organs of the body from which further beneficial influence may be derived. (auth)

14576 PHATHOMORPHOLOGIC FINDING IN GUINEA PIGS WITH EXPERIMENTAL TUBERCULOSIS EXPOSED TO X RAYS AND SOME BIOCHEMICAL CHARACTERISTICS OF THE ISOLATED STRAINS. Vasilev, V. (Meditsinska Akademiya, Sofia); Vylchanov, V. Epidemiol., Mikrobiol. Infekts. Boles.; 11: No. 1, 53-58(1974). (In Bulgarian).

Results are reported of two experiments on a total of 140 guinea pigs, part of them inoculated and then irradiated, others exposed to x rays and then inoculated with strain $H_{37}Pv$. Tuberculosis lesions were greater in irradiated animals indicating minor resistance of the animal organism. There were changes in peroxydase productiveness of tubercle bacterium strains isolated from infected and then irradiated guinea pigs. (auth)

14577 PHOSPHOGLUCOISOMERASE IN THE LIVER, SERUM, AND ERYTHROCYTES OF RATS AFTER WHOLE-BODY X-RAY IRRADIATION AT A DOSE OF 600 R AND SIMULTANEOUS FASTING. Zikes, V.; Tusl, M. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.; 16: No. 3, 233-240(1973). (In Czech).

The activity of phosphoglucoisomerase (PGI) was followed up in the liver, erythrocytes, and the serum of female rats after whole-body x-ray irradiation by a total dose of 600 R. The rats were fasting for a period of 10 days starting from the day of irradiation. The results were compared with groups of irradiated-fed and non-irradiated-fed or -fasting animals. In the group of rats fasting after irradiation the PGI activity in the liver, serum, and erythrocytes was found to be significantly higher than in the group of non-irradiated fasting animals. From the activities determined in vitro it is obvious that fasting moderates slightly the increasing trend of activities caused by x-ray irradiation while irradiation has a much stronger effect on the decrease in PGI activity induced by fasting. The mechanism of these changes is still obscure. (auth)

14578 PHOSPHOGLUCOMUTASE IN THE LIVER OF RATS EXPOSED TO WHOLE-BODY IRRADIATION WITH 600 R AND SIMULTANEOUS FASTING. Zikes, V.; Tusl, M. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.; 16: No. 2, 115-120(1973). (In Czech).

Liver phosphoglucomutase was studied in female rats after whole-body irradiation with a total dose of 600 R and simultaneous fasting. In the course of 10 days of study, the activity of the enzyme in the non-purified supernatant after centrifugation of liver homogenate was found to change only slightly in comparison with non-irradiated fed control groups. Fasting alone causes a significant decrease in the activity as early as after 24 hours while irradiation alone of fed rats leads to a significant increase in the activity of liver phosphoglucomutase after 24 hours. With the present knowledge of this enzyme, the mechanism of the observed changes cannot be accounted for. (auth)

14579 EFFECT OF TOTAL BODY IRRADIATION ON ERYTHROPOIESIS IN 20-DAY-OLD RATS. Carnevali, C.; Rizzoli, V.; Delsignore, R.; Sansoni, P.; Rossi, G. (Parma Univ., Italy). Ateneo Parmense, Sez. 1; 45: 59-65(Jan 1974). (In Italian).

The effect of total-body irradiation (200 R) at birth, on erythropoiesis of the 20-day-old rat, was evaluated. In the irradiated animals, polycythemia and starvation did not suppress erythropoiesis to the same extent seen in the unirradiated controls. Furthermore, after 72 hours of starvation the mitotic erythroid index increased for metaphase accumulation, as observed in the 10-day-old-starved rat. The data support the hypothesis that irradiation lengthens the maturation time of the fetal committed stem cell, retarding the oxygen-dependant adult type mechanism of humoral regulation of erythropoiesis. (auth)

14580 CELLULAR RADIOSENSITIVITY OF A RAT BRAIN TUMOR. Leith, J. T.; Schilling, W. A.; Wheeler, K. T. (Univ. of California, Berkeley). Cancer; 35: No. 6, 1545-1550(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

The response of a model brain tumor system in the rat to single doses of x irradiation has been studied. Solid tumors were exposed in situ, removed, dissociated into single cells, and grown in tissue culture. The fraction of surviving clonogenic cells was determined as a function of x-ray dose level for tumors irradiated in anesthetized, air-breathing rats, and for tumors irradiated in rats killed 5 minutes prior to irradiation by nitrogen gas asphyxiation. The parameters of the survival curve for tumors irradiated in air-breathing rats were: D_0 equals 295 rads; D/sub q/ equals 350 rads; and n equals 3.0. Similarly, the survival parameters for tumors irradiated in nitrogen gas asphyxiated rats were: D_0 equals 625 rads; D/sub q/ equals 675 rads; and n equals 3.0. The survival curve of these tumor cells when assayed in in vitro tissue culture only has parameters of: D_0 equals 225 rads; D/sub q/ equals 350 rads; and n equals 4.7. Data from the in vivo to in vitro tumor cell survival curves suggest that there is no significant hypoxic fraction in this brain tumor. (auth)

14581 MODIFICATION OF RADIATION INJURY TO NORMAL TISSUES BY CHEMOTHERAPEUTIC AGENTS. Phillips, T. L.; Wharam, M. D.; Margolis, L. W. (Univ. of California, San Francisco). Cancer; 35: No. 6, 1678-1684(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

The effects of several cancer chemotherapeutic agents on radiation damage to normal intestine, esophagus, and lung tissue were evaluated in LAF_1 mice using quantitative endpoints. In all tissues tested, actinomycin D increased injury and BCNU did not. In the intestine, adriamycin enhanced radiation damage more than any other agent. Bleomycin increased damage in the esophagus but not in the lung or intestine. Cyclophosphamide increased injury only in the lung, where vincristine caused minimal injury, and hyroxyurea, none. Only prednisolone caused significant radioprotection when given at the time of irradiation or at the time of expected death from pulmonary injury. (auth)

14582 EFFECT OF AGE ON THE LONG-TERM RESPONSE OF BONE MARROW TO LOCAL FRACTIONATED IRRADIATION. Fishburn, R. I.; Dobelbower, R. R. Jr.; Patchefsky, A. S.; Leeper, D. B.; Kramer, S. (Thomas Jefferson Univ. Hospital, Philadelphia). Cancer; 35: No. 6, 1685-1691(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

The in-field long-term progressive response of bone marrow to localized fractionated radiation to the thoracic spine was observed in weanling and adult rats. Total dose levels were 1800, 3600, and 5400 rads given in daily fractions of 180 rads for 900 rads per week, to simulate the clinical setting. Animals were sacrificed at $4\frac{1}{2}$, 6, 8, and 10 months after irradiation, and bone marrow from within the treated area was examined. The juvenile marrow repopulated to higher levels of cellularity and after higher doses of radiation than the adult. The degree of marrow depletion, time of repopulation, and ultimate level of repopulation after cessation of irradiation were all dependent on the total dose. Some of the suggested clinical implications include reevaluation of the lower doses given to children. (auth)

14583 TOLERANCE OF THE SPINAL CORD OF RATS TO IRRADIATION WITH CYCLOTRON-ACCELERATED HELIUM IONS. Leith, J. T.; Lewinsky, B. S.; Woodruff, K. H.; Schilling, W. A.; Lyman, J. T. (Univ. of California, Berkeley). Cancer; 35: No. 6, 1692-1700(Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Spinal cords of rats were exposed to either single doses of helium ions ranging from 500 to 3500 rads, or to fractionated doses of helium ions ranging from 1330 to 6530 rads using 10 equal fractions given over 22 days. Both plateau and spread-out Bragg peak regions of ionization were used. For single doses there was no difference between plateau or spread-out Bragg peak ionization regions for production of paralysis; the tolerance dose for production of paralysis was about 1900 rads. For the fractionation experiment, there was also no difference between plateau or spread-out Bragg peak ionization regions for production of paralysis; the tolerance dose was between 5220 and 6530 rads. Comparison of dose levels producing about 10 percent partial paralysis indicates that about 500 rads of dose is recovered between fractions. In both single dose and fractionated experiments, latency between onset of paralysis was between 20 to 24 weeks. (auth)

Invertebrates

14584 GENERAL DISCUSSION. van Heemert, C. (Landbouwhogeschool, Wageningen, Netherlands). pp 68-76 of Chromosomal Rearrangements in the Onion Fly Hylemya Antiqua (Meigen), Induced and Isolated for Genetic Insect Control Purposes. van Heermert, C. (ed.). Wageningen, Netherlands; Landbouwhogeschool (1975).

The conclusion is argued that a low dose of 0.5 krad of x rays is most suitable for the induction of chromosomal rearrangements to be used for genetic control purposes. The translocations and inversions obtained are listed and discussed. Some translocations were selected for further experiments which are described in previous chapters but are surveyed in this discussion. (NL)

14585 FURTHER STUDIES ON HETEROZYGOUS EFFECTS OF RADIATION ON VIABILITY OF DROSOPHILA MELANO-

GASTER. Pandey, J. (Univ. of Wisconsin, Madison). Mutat. Res.; 27: No. 2, 249-253(Feb 1975).

Drosophila second chromosomes that had received a dose of 1000 R of x rays were studied for heterozygous effects of newly induced mutations on viability. In both homozygous and heterozygous backgrounds, the mean effect of radiation was not significantly different from zero. (NL)

14586 HETEROZYGOUS EFFECTS OF X-RAY INDUCED MUTATIONS ON VIABILITY OF DROSOPHILA MELANOGASTER. Muruyama, T. (Univ. of Wisconsin, Madison); Crow, J. F. Mutat. Res.; 27: No. 2, 241-248(Feb 1975).

Drosophila second chromosomes that had received 1000 R of x-radiation mainly in the mature sperm stage were tested for heterozygous effects on viability. When the genetic background was heterozygous the viability was reduced by about 1.5 percent; in a nearly homozygous background the viability was enhanced by about the same amount. In a partially inbred background the results were intermediate. (NL)

14587 MEIOTIC DISJUNCTION, SEX-DETERMINATION, AND EMBRYONIC LETHALITY IN AN X-LINKED SIMPLE TRANSLOCATION OF THE ONION FLY, HYLEMYA ANTIQUA (MEIGEN). van Heemert, C. (Landbouwhogeschool, Wageningen, Netherlands). pp 37-52 of Chromosomal Rearrangements in the Onion Fly Hylemya Antiqua (Meigen). van Heermert, C. (ed.). Wageningen, Netherlands; Landbouwhogeschool (1975).

It was shown that the translocation in the study is X-linked. After testcrossing translocation heterozygous males they generally only produce translocation heterozygous daughters and normal sons. The small acrocentric chromosomes involved in the translocation appeared to be the sex-chromosomes. The X-chromosome has a secondary constriction which is missing in the (male determining) Y-chromosome. Meiotic orientation was studied in translocation heterozygous males and females. The alternate and adjacent I orientations were found in about equal frequencies. Further, numerical meiotic nondisjunction (two types) occurred in translocation heterozygous males (about 2%), but is much higher in females (18.7%). In (achiasmate) males the homologous centromeres predominantly regulate meiotic pairing, coorientation, and disjunction, apparently independently of the chromosomal rearrangement. Disturbed telomere pairing in particular leading to reduced chiasma frequency most probably explains the high numerical non-disjunction in chiasmate females. A rather good relationship exists between the percentage semisterility (28%), scored as late embryonic lethals (eggs, 72 hrs.) and the percentage karyotypes (20%) in young eggs (8 to 16 hrs.) with a large chromosomal deficiency. The remaining sterility (8%) can be explained by the somewhat decreased viability of tertiary trisomics and duplication karyotypes at the end of the egg stage. This translocation behaves like a simple one. (NL)

14588 GENETIC RADIATION DAMAGE AND FOOD IN DROSOPHILA MELANOGASTER (MEIGEN). The Influence of the Live Yeast in the Food upon the Frequency of Sex-Linked Lethals Induced by X Rays during Spermatogenesis. Schouten S. C. M. Utrecht; Rijksuniversiteit (1973). 82p. (In Dutch). Thesis.

The influence of the presence of live yeast in the food of the adult wild-type Drosophila males upon the frequency of x-ray induced dominant and sex-linked recessive lethal mutations was studied. Sensitivity to x rays is highest in early spermatids and spermatocytes. These stages responded with a decrease in induced sex-linked recessive lethal mutations to a deficiency of live yeast in the food. Also RNA synthesis in the testes of males fed with live yeast-deficient food was reduced. Arguments are presented that the yeast effect is due to impaired efficiency of a repair process of chromosomal breaks in yeast-deficient animals. (NL)

14589 MEIOTIC DISJUNCTION AND EMBRYONIC LETHALITY IN TRISOMICS DERIVED FROM AN X-LINKED TRANSLOCATION IN THE ONION FLY, HYLEMYA ANTIQUA (MEIGEN). van Heemert, C. (Landbouwhogeschool, Wageningen, Netherlands). pp 53-67 of Chromosomal Rearrangements in the Onion Fly Hylemya Antiqua (Meigen). van Heermert, C. (ed.). Wageningen, Netherlands; Landbouwhogeschool (1975).

Translocation- and tertiary trisomics (for the X-chromosomes) were obtained after testcrossing translocation heterozygous females of an X-linked simple translocation stock. Meiotic disjunction as judged from segregations at M II (males) and in young eggs of testcrosses (males and females) in translocation trisomics was studied. No progeny of tertiary trisomic males and females was found, but male M II could be studied. Six different orientation types appeared in translocation trisomic (2n + 1) males and these were present in equal frequencies. No adjacent II configurations were found. The small X- and Y- chromosomes and the large translocated X-chromosome of the translocation complex disjoin at random (n and n + 1 gametes) in both translocation trisomic females, four different orientation types appeared. From the high frequency of two of these (together, 94.5%) it is concluded that the two normal X-chromosomes show preferential pairing and disjunction, while the translocated X-chromosome moves to either one of the two poles at random. Primary trisomic (for the X-chromosome) males (XXY) and females (XXX) were obtained from test-crossed translocation trisomics. Cytological analysis of adult male progeny of testcrossed XXY males showed that no random orientation for the X-, X- and Y-chromosomes occurred because half of the sons were disomic (XY) and half of them trisomic (XXY). A possible mechanism is discussed. Analysis of young eggs of testcrossed XXX females indicated a segregation of 2X:1X = 1:1. The level of semi-sterility as scored from testcrosses of translocation trisomics appeared to be as in translocation heterozygotes. Here again a close relation exists between semi-sterility and deficiencies in eggs for a large chromosomal segment. The possible use of this translocation for genetic control of insect pests is discussed. (NL)

14590 STUDIES ON THE STERILE MALE TECHNIQUE AS A MEANS OF CONTROL OF ADOXOPHYES ORANA (LEPIDOPT., TORTRICIDAE). III. An Evaluation of Competitiveness of Laboratory-Reared Moths. Denlinger, D. L. (Landbouwhogeschool, Wageningen, Netherlands); Ankersmit, G. W.; Noordink, J. P. W. Neth. J. Plant Pathol.; 79: No. 6, 229-235(1973).

Mating competitiveness of an inbred irradiated, mass reared strain of Adoxophyes was approximately half that of males collected as nearly fullgrown larvae or pupae in the field. This reduction was not caused by irradiation effects. No indications of genetic inferiority of the laboratory strain were found since the difference in competitiveness disappeared after wild moths were reared for one generation on artificial diet. A diet effect on competitiveness seems most likely. (auth)

14591 COMBINED EFFECTS OF HEAT AND RADIATION ON THE FREQUENCY OF EYE COLOR MUTATIONS AND MALFORMATIONS IN DAHLBOMINUS. Baldwin, W. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mutat. Res.; 27: No. 1, 143-145(Jan 1975).

14592 REARING, REPRODUCTIVE BEHAVIOR, AND GAMMA STERILIZATION OF FRUIT FLY, DACUS ZONATUS (DIPLERA: TEPHRILIDAE). Qureshi, Z. A.; Ashraf, M.; Bughio, A. R.; Hussain, S. (Atomic Energy Agricultural Research Centre, Tandaja, Pakistan). Entomol. Exp. Appl.; 17: No. 4, 504-510 (1974).

Investigations were made on rearing, reproductive behavior, and gamma sterilization of one-day old male adults of Dacus zonatus. The larvae were successfully reared on an artificial diet based on wheat shorts. Adult emergence ranged from 89 to 99% with a sex ratio of about 1 : 1. Mating occurred at dusk and its duration ranged from 8 to 13 hours. Males mated a second time with the same female but preferred mating if the already mated female was replaced with a sexually mature virgin female. The optimum dosage for inducing sterility amongst one-day old male adults was 12 kR. (NL)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 14277, 14285, 14286, 14302, 14500, 14503, 14513, 14544, 14609, 14610, and 14622.

14593 (BMI-171-143) PRETEST ESTIMATES OF HYPOTHETICAL INTERNAL RADIATION DOSES FROM CANNIKIN VIA MARINE FOOD CHAINS. Bloom, S. G.; Howes, J. E.; Ewing, R. A.; Raines, G. E. (Battelle Columbus Labs., Ohio (USA)). Jun 1975. Contract AT(26-1)-171. 37p. Dep. NTIS $4.00.

A hypothetical prompt accidental release of radioactivity to the atmosphere from the Cannikin event was assumed and the resulting potential internal radiation doses to human populations via marine food chains were estimated using previously derived mathematical models. (auth)

14594 (CONF-750633-2) DISCUSSION: IDENTIFICATION OF CARCINOGENS, TUMOR PROMOTERS, AND COCARCINOGENS IN TOBACCO SMOKE. Guerin, M. R. (Oak Ridge National Lab., Tenn. (USA)). 1975. 13p. Dep. NTIS $4.00.

From 3rd world conference on smoking and health; New York City, New York, USA (2 Jun 1975).

Various aspects of tobacco carcinogenesis are reviewed. Some topics discussed are: role of ^{210}Po and alpha radiation in tobacco carcinogenesis; role of nickel carbonyl and nickel subsulfide; gas chromatographic profiles of the gas phase organic

constituents delivered by different cigarettes; comparison of chromatographic response with biological activity; and identification of carcinogens, promoters, and cocarcinogens. (HLW)

14595 (COO-3017-19) SKELETAL AND TISSUE LESIONS RESULTING FROM EXPOSURE TO RADIUM AND FISSION PRODUCTS. Warren, S. (New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). 1973. Contract AT(11-1)-3017. 18p. (CONF-741166-1). Dep. NTIS $4.00.

From conference on the Association of Clinical Scientists; Philadelphia, Pennsylvania, USA (8 Nov 1974).

The chief effects of absorbed radionuclides and external radiation are radiation osteitis, disturbed bone growth, myelofibrosis, and bone tumors. The lesions in part are dependent on localization and character of the radiation, in part on dose. Data on radium were derived from dial painters, radium chemists and those treated some years ago by oral or parenteral administration. (auth)

14596 HISTOLOGIC TYPES OF LUNG CANCER AT DIFFERENT EXPOSURE TO RADON DAUGHTERS. Placek, V.; Sevc, J.; Suda, J. (Inst. of Hygiene and Epidemiology, Prague). pp 237-250 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Histologic studies were conducted on a large group of uranium miners to determine the cell types of lung cancer in relation to different conditions of radiation exposure. The analysis of results according to the time course of accumulation of exposure shows that in groups with equable yearly exposure rates and decreasing exposure rates the relative frequencies of the histologic types do not differ significantly when compared with a control group. The results of preliminary observations point to the importance of detailed follow up of histologic types of cancer especially in relation to the time course of accumulation of exposure and to the period between the start of exposure and death. (ERB)

14597 RADIATION INDUCED LUNG CANCER: RELATION BETWEEN LUNG CANCER AND LONG-TERM EXPOSURE TO RADON DAUGHTERS. Sevc, J.; Placek, V. (Inst. of Hygiene and Epidemiology, Prague). pp 305-310 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The results of the authors observations on the relation between the incidence of lung cancer and lung-term exposure to radon daughters in uranium miners are compared to some foreign results. The possibility of applying these results to the assessment of the acceptable occupational exposure is discussed. Conclusions regarding the establishment of acceptable WLM (working level months) are based on the authors' and foreign epidemiological studies. Results of these studies confirm that 3 WLM, corresponding to a yearly intake of ^{222}Rn daughters of $8 \cdot 10^{10}$ MeV, may be considered to be an acceptable yearly exposure. (ERB)

14598 STUDY GROUP: ENDOLYMPHATIC RADIONUCLIDE THERAPY. Peters, P. E. (Univ., Muenster, Ger.). Med. Welt; 25: No. 23, 1056-1058(7 Jun 1974). (In German).

The purposes, aims and preliminary results of a study on endolymphatic radionuclide therapy are outlines. The necessity of a close cooperation with the dermatologists in the treatment of malignant melanomas by endolymphatic radionuclide therapy is stressed. Experiences with radionuclide therapy of malignant melanomas and in the endolymphatic treatment of malignant lymphomas are reported briefly. (tr-auth)

14599 INDICATIONS, CONTRAINDICATIONS, AND ADVERSE EFFECTS OF ENDOLYMPHATIC RADIONUCLIDE THERAPY. Weissleder, H. (Deutsche Klinik fuer Diagnostik, Wiesbaden, Ger.). Med. Welt; 25: No. 23, 1028-1031(7 Jun 1974). (In German).

Stage I malignant melanomas of the lower extremities represent an unqualified indication for endolymphatic radionuclide therapy. The therapeutic procedure in other locations or stage II of the melanoma must be made from an evaluation of the situation of each individual case. In lymphatic system diseases endolymphatic radionuclide therapy can have only the effect of a supplementary treatment. Recommendations on the volume and radiation dose of the radionuclides used and the procedure followed result in only a small risk to the patient when made by an experienced radiologist. (tr-auth)

14600 THOROTRAST INDUCED TISSUE LESIONS. Schwarz, E.; Seiler, U. Praxis (Bern); 63: No. 6, 149-156(12 Feb 1974). (In German).

The pharmacology and radiation biology of thorotrast, a contrast medium-previously used, are discussed in the first part of the presentation. This agent thorium-dioxide is usually accumulated in the RES or may be found around the injection site or the vicinity of it. After a latency period of 6 at 40 years radiation effects and local tissue damage known as thorotrastoma appear at the injection site or damage to the organs themselves due to radiation like dystrophia of the liver, fibrosis of the spleen, atrophy of the bone marrow, or renal cirrhosis develops. Occurring malignancy has been reported though more often fibrosis of the thorotrast injected tissue may develop. Part two presents seven cases with the known thorotrast damage. The damage sites being four times the RES, twice chronical subcutaneous lesions at the injection site, and once hydronephrosis with terminal uremia due to thorotrast incurred retroperitoneal fibrosis. The last part discloses insurance claims, and a refusal of liability benefits in evidence a 40 years old latency. (auth)

14601 ANATOMICAL PREREQUISITES FOR ENDOLYMPHATIC RADIONUCLIDE THERAPY. Kubik, S. (Univ., Zurich). Med. Welt; 25: No. 23, 1011-1016(7 Jun 1974). (In German).

In order to evaluate the therapeutic effectiveness of radionuclide therapy of metastases, their mode of origin must be reviewed. The questions related to this problem area can best be studied by limiting as much as possible the region considered. In the present discussion only the lymphatic system of the lower extremities are considered. The following problems are discussed within this limitation: circulation between the afferent lymph vessels and regional nodes, function of the lymph nodes, location of the metastases, barrier function and filter capacity of the lymph nodes, filling of the diseased nodes, central metastases, retrograde metastases, and contralateral metastases. (JSR)

Animals

Refer also to abstracts 14275, 14563, 14614, and 14631.

14602 EFFECTS OF LONG-TERM INTERNAL CONTAMINATION WITH ^{144}Ce-^{144}Pr on ^{3}HtdR UPTAKE IN RAT SPLEEN CELLS. Beno, M. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 25-30 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The effect of long-term internal contamination with ^{144}Ce-^{144}Pr on cell kinetics in the spleen of rats were studied using autoradiography and subsequent differential counting of various cell populations. (auth)

14603 INDUCTION OF OSTEOSARCOMAS IN MICE BY REPEATED ADMINISTRATION OF ^{224}Ra. Dvorak, V. (Charles Univ., Prague); Holusa, R.; Julisova, D.; Malatova, I.; Onyskowova, Z.; Svoboda, V. pp 55-59 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The mouse skeleton dose resulting from ^{224}Ra activities repeatedly administered at the TC level intended to correspond to approximately 30/uCi of ^{226}Re/kg, lies in the region of the ^{224}Ra activities at which, with the administration scheme selected, it is possible to obtain a high productive effect of osteogenic sarcomas. (auth)

14604 INDUCTION OF OSTEOSARCOMAS IN MICE WITH DIFFERENT LEVELS OF EXPOSURE FROM REPEATED ADMINISTRATIONS OF ^{224}Ra. Dvorak, V. (Charles Univ., Prague); Julisova, D.; Malatova, I.; Onyskowova, Z.; Svoboda, V. pp 61-65 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The skeletal dose resulting from repeated ^{224}Ra administrations to mice at the TB level (intended to correspond to approx. 10/uCi of ^{226}Ra/kg received in a single injection) lies in the region of activities that show considerable production of osteogenic sarcomas, with frequent findings of multifocal tumors. The production of osteogenic sarcomas was higher than at the TC level, where three times higher activities were injected. (auth)

14605 PERIPHERAL BLOOD COUNT CHANGES AFTER INCORPORATION OF ^{226}Ra AND ^{224}Ra IN MICE. Onyskowova,

Z.; Kofranek, V.; Dvorak, V. (Inst. of Hygiene and Epidemiology, Prague). pp 219-220 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The peripheral blood count in mice at various time intervals following the administration of ^{224}Ra and ^{226}Ra was studied. Time intervals of 2, 6, 12, and 18 months after administration were used. The hematological data included hematocrit, leukocyte, reticulocyte, lymphocyte, monocyte, and neutrophil counts. The differences between the effects of long- and short-lived isotopes of radium are discussed. (ERB)

Plants

14606 ACTION OF LITHIUM IONS AND HEAVY WATER IN SLOWING CIRCADIAN RHYTHMS OF PETAL MOVEMENT IN KALANCHOE. Engelman, W. (Inst. fuer Biologie, Tuebingen, Ger.); Maurer, A.; Muehlbach, M.; Johnson, A. J. Interdiscip. Cycle Res.; 5: No. 3/4, 199-205(Dec 1974).

Lithium ions and deuterium oxide effectively increase the period length of the circadian petal movement of Kalanchoë flowers. Most circadian rhythms, including the one studied here, are easily phase shifted by pulses of light. The amount and direction of phase shift depend on the time in the circadian cycle at which the light pulse is administered, and are usually graphically plotted in a so-called phase-response curve or in phase-response diagrams. The circadian nature of the light-sensitive oscillator is reflected in the daily recurrence of similar responses towards light pulses. This feature has been used to differentiate between changes of the behavior due to changes in the light-sensitive oscillator itself and those due to changes in more peripheral oscillators which are driven by the light-sensitive oscillator. The authors have employed this method in an attempt to find out whether the period-lengthening effect of D_2O and Li^+ reflects a lengthening of the period of the driving light-sensitive oscillator or not. This period-lengthening effect by heavy water was demonstrated. It has furthermore been tried to test the possibility, that D_2O lengthens the period by its phase-delaying action. (NL)

Microorganisms

14607 COMPARISON OF MUTAGENIC EFFICIENCY OF DECAY OF ^{32}P INCORPORATED IN E. COLI WP-2 AND E. COLI WP-2S CELLS. Pluciennik, H. (Warsaw Univ.). Acta Microbiol. Pol., Ser. A; 7: No. 2, 99-105(1975).

The ^{32}P-labeled Escherichia coli WP-2 and Escherichia coli WP-2S cells were stored at -196°C. The lethal effect induced by ^{32}P decay was equal in both strains. Lethal efficiency of $^{32}P \rightarrow {}^{32}S$ transmutation in DNA amounted to 0.046. Reversion try$^-$ → try$^+$ were induced with a ten times higher efficiency in uv-sensitive strain WP-2S, as compared with strain WP-2. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 13744, 14311, 14316, 14507, 14510, 14513, 14529, and 14595.

14608 (CONF-750622-3) IMPORTANCE OF INITIAL MANAGEMENT OF PERSONS INTERNALLY CONTAMINATED WITH RADIONUCLIDES. Lincoln, T. A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 14p. Dep. NTIS $4.00.

From American industrial hygiene conference; Minneapolis, Minnesota, USA (1 Jun 1975).

The first one to three hours following a radiation accident during which internal contamination occurs provide the best and perhaps the only opportunity for preventing uptake of radionuclides. By using chemical manipulation in the GI tract or by hastening the material through the body, absorption can be reduced. Once absorbed, uptake in specific tissues can often be prevented by blocking agents, isotopic dilution or chelating agents. In order to supply prompt treatment, the medical department must have a well-defined action plan based on knowledge of the plant of laboratory operations, the radionuclides used, and medications required. (auth)

14609 INVESTIGATION OF IMMUNOGLOBULIN LEVELS IN BLOOD SERUM OF URANIUM MINERS. Andrlikova, J.; Wagner, V. (Inst. of Industrial Hygiene in Uranium Industry, Pribram, Czech.). pp 5-9 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The effect of one year exposure on the Ig levels in the blood of uranium miners in the Hamr district was determined. Measurements were taken of Ig levels immediately upon starting work in the mines and repeated one year later. The results indicate that the Ig levels were sensitive to the chronic exposure to ionizing radiation levels found in the mines. The influence of other factors in the working environment on the Ig levels could not be ruled out. (ERB)

14610 INFLUENCE OF WORK-STRESS ON LEVELS OF IMMUNOGLOBULINS (IgG, IgA, IgM) OF MINERS IN URANIUM MINES. Andrlikova, J.; Wagner, V.; Palek, V. (Dept. of Experimental Biology, Kamenna, Czech.). pp 11-24 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

In two groups, each of 22 miners, exposed 5.45 and 10.4 years to the milieu of uranium mines, the serum levels of IgG, IgA, and IgM were measured before and after one workshift. In the longer exposed group, the work stress produced a significant decrease of all three classes of Ig. In the shorter exposed group only the IgG decreased significantly. In the longer exposed group, the initial levels of IgG were significantly lower in comparison with shorter exposed group. (auth)

14611 DEVELOPMENT OF THE ^{90}Sr CONTENT IN THE SKELETON IN CSR. Brezik, Z.; Brezikova, D.; Kunz, E.; Namestek, L. (Inst. of Hygiene and Epidemiology, Prague). pp 31-35 of Proceedings of the 6th conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Strontium 90 concentrations in the skeleton of newborn children and adults from South Moravia and Middle Slovakia for the years 1968 to 1971 are presented. The new data confirm the previously observed dependence of ^{90}Sr values on age. Highest concentrations were found in children about one-year-old. Values decreased with advancing age. (ERB)

14612 EXCRETION OF TRITIUM IN WORKERS PREPARING LABELLED COMPOUNDS. Houskova, M.; Cajkova, A.; Kunz, E.; Namestek, L. (Inst. of Hygiene and Epidemiology, Prague). pp 91-101 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The excretion of tritium was systematically followed up in workers engaged in the synthesis of labelled compounds and in workers operating neutron generators with the aim to improve the methods of measurement and evaluation of exposure to tritium. Samples of urine and exhaled breath were analyzed for HTO and organically bound tritium. It was found that the determination of tritium in the form of HTO only can lead to serious underestimation of the exposure. (ERB)

14613 POSSIBILITIES OF UTILISATION OF THE GROSS BETA-GAMMA ACTIVITY OF URINE CORRECTED FOR THE PRESENCE OF ^{40}K FOR ESTIMATING THE SERIOUSNESS OF CONTAMINATION. Molgye, Z.; Chysky, J.; Popper, J.; Garba, A. (Inst. of Industrial Hygiene in Uranium Industry, Pribram, Czech.). pp 103-109 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

It was previously shown that by means of a simple method of measurement of the gross beta-gamma activity of urine, the seriousness of internal contamination by some beta emitter might be estimated. It was found that the sensitivity of this method could be increased by subtracting the ^{40}K activity calculated from potassium concentration determined in urine by flame photometry. The increase is of an order of magnitude and is especially effective with nuclides having low energies. (ERB)

14614 PROCEEDINGS OF THE 6TH CONFERENCE ON RADIATION HYGIENE. II. Conference Held at Jasna Pod Chopkom, Czechoslovakia, November 27-29, 1973. Trnovec, T.; Stojkovic, J. (eds.). Hradec Kralove, Czechoslovakia; Purkyne Medical Research and Postgraduate Institute Press (1973). 178p. (CONF-731171-P2).

Separate abstracts were prepared for 22 papers presented in these proceedings. (ERB)

For abstracts of individual papers see: 13800, 14308, 14365, 14512, 14513, 14596, 14597, 14605, 14615–14618, 14626–14632, 15052, 16260, and 16691.

14615 DISTINGUISHING SURFACE CONTAMINATION FROM INTERNAL CONTAMINATION BY WHOLE-BODY COUNTING IN VIVO. Lenger, V. (Inst. of Hygiene and Epidemiology, Prague). pp 173-179 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Among the many problems of directly measuring internal contamination by whole-body counting is the necessity to distinguish between it and surface contamination. The resolution offered by the authors, in the case of beta-gamma emitters, is the use of two NaI(Tl) crystals in coincidence. The resultant coincidence spectra make it possible to distinguish between surface and internal contamination. (ERB)

14616 RESULTS OF RADIOCHEMICAL ANALYSIS OF BODY COMPARTMENTS IN DEAD URANIUM MINERS. Musil, K.; Vich, Z.; Bischof, R. (Health Inst. of Uranium Industry, Pribram, Czech.). pp 191-197 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Uranium, ^{226}Ra, and ^{210}Pb contents in body compartments of eight dead uranium miners were investigated. The mean values were higher than those for unexposed populations given in the literature, but on the other hand, lower than the last American values. Although it is necessary, for more exact appreciation, to extend the investigated group, it was concluded that the hygienic conditions, from point of view of long-lived radionuclides, are relatively favorable in Czechoslovak uranium mines. (auth)

14617 CHARACTER OF ^{144}Ce BINDING TO THE BONE COLLAGEN. Tatara, M.; Vladar, M. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 311-315 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Kinetic analysis following internal contamination of rats showed that 85% of the ^{144}Ce was bound to the organic matrix of bone in its growing interface. Fractionation studies revealed that 80% of the ^{144}Ce was bound to collagen macromolecules. It is proposed that the Ce^{3+} ions are bound to collagen through carboxy groups where in the next step they are stabilized by the covalent bonds to the nitrogen of amino groups and probably to the oxygen of hydroxy groups as well. (ERB)

14618 DETERMINATION OF THE ^{226}Ra BODY BURDEN SOLELY ON BASIS OF RADON EXHALATION MEASUREMENT OR WHOLE-BODY COUNTING OF GAMMA RADIATION. Thomas, J. (Inst. of Hygiene and Epidemiology, Prague). pp 317-321 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Emanometrical measurements of radon exhalation and whole-body counting are used together to determine the ^{226}Ra body burden. The possibility of determining the ^{226}Ra body burden solely on the basis of one of these measurements is proposed. The proposal is based on two known empiric laws regarding the time course of the radium body burden and radon retention in the skeleton. The time course curves are based on an assumed single intake of ^{226}Ra in a soluble form. (ERB)

14619 USE OF PROTACTINIUM-233 AS A SIMULATOR OF PLUTONIUM-239 FOR LUNG DOSIMETRY. Nikpay-Aslie, P. (Teheran Univ. (Iran)). Radioprotection; 9: No. 3, 205-210(1974). (In French).

For the measurement of a pulmonary charge by ^{239}Pu, an emitter of x rays of very low energies, a method has been suggested consisting of administering to the patient an aerosol of ^{233}Pa. In effect, the ^{233}Pa with a short period, emits in addition to the same x rays a photon γ of 310 KeV allowing the measurement of the administered charge. For the measurement of low energies, the possibilities of a scintillation detector and proportional counter have been compared, by means of measurement made on an anthropomorphous phantom tissue-equivalent material. The proportional counter permits the measurement of x rays and the use of ^{233}Pa as a simulator of ^{239}Pu. (FR)

14620 PHYSICO-CHEMICAL EVOLUTION OF MIXTURES OF SODIUM AND PLUTONIUM OXIDE AEROSOLS. Metivier, H. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France). Section de Pathologie et de Toxicologie Experimentales). Radioprotection; 9: No. 3, 187-191(1974). (In French).

The industrial development of molten sodium cooled fast breeders is raising new problems to the biologists interested in plutonium toxicity. In the event of an accident, the chemical form the most likely to be found for plutonium associated to sodium shall be an oxidized form Pu VI or Pu VII, which is soluble at the pulmonary level. (FR)

14621 EMERGENCY THERAPY OF LUNG RADIOCONTAMINATION BY SELF-CONTAINED DTPA AEROSOL GENERATOR. Ducousso, R.; Girerd, E.; Pasquier, C. (Centre de Recherches du Service de Sante des Armees, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Radioprotection; 9: No. 3, 173-186(1974). (In French).

Previous experiments have demonstrated that DTPA aerosols should be administered by inhalation as soon as possible following a suspected accidental inhalation of plutonium, transplutonic elements, yttrium, or rare earths. This emergency treatment requires that each exposed individual should have his own portable aerosol generator. Two generators were tried: the SPINHALER turboinhalator seemed to answer the conditions required satisfactorily. (FR)

14622 ESTIMATION OF RADIATION DOSAGE AND TRANSMUTATION EFFECT OF ^{14}C INVOLVED IN MEASURING RATE OF ALBUMIN SYNTHESIS WITH ^{14}C-CARBONATE. Yap, A. H.; Hafkenscheid, J. C. M.; Goossens, C. M. I. C.; Buys, W. C. A. M.; Binkhorst, R. A.; Van Tongeren, J. H. M. (Univ. of Nijmegen, Netherlands). J. Nucl. Med.; 16: No. 7, 642-648(Jul 1975).

For direct measurement of the rate of albumin synthesis, $Na_2{}^{14}CO_3$ was used intravenously. The assessment of the radiation hazard involved in the study was based on the knowledge of the minimum dose of $Na_2{}^{14}CO_3$ necessary for a sufficient incorporation of ^{14}C in the guanidine-C of arginine in albumin to obtain measurable radioactivity. By measurement of expired $^{14}CO_2$ and excreted ^{14}C-urea in the urine during a 5-hr period following intravenous administration of $Na_2{}^{14}CO_3$ in five subjects, some quantitative data on ^{14}C retention and radiation dosage were obtained. In comparison with animal studies, the rate of expiration of $^{14}CO_2$ in man is slower. About 50 percent of the total radioactivity injected was lost through the respiratory route in the first hour. The total amount of expired ^{14}C during the 5 hr of investigation was about 75 percent of the injected dose for the five subjects. The amount of ^{14}C excreted as urinary ^{14}C-urea during the 5 hr of investigation is very small in comparison with the expired ^{14}C; it was only about 0.5 percent of the dose injected. The total absorbed radiation dose after complete elimination of ^{14}C from the body was calculated with various assumptions. The extra risk of genetic damage due to disintegration of retained ^{14}C in comparison with that of natural ^{14}C in the body during 30 living years is about 50 percent. (auth)

Animals

Refer also to abstracts 14275, 14713, and 14738.

14623 PRODUCTION OF URINARY SELENIUM METABOLITES IN THE RAT FOLLOWING $^{75}SeO_3^{=}$ ADMINISTRATION. Kiker, K. W.; Burk, R. F. (Letterman Army Inst. of Research, Denver). Am. J. Physiol.; 227: No. 3, 643-646(Sep 1974).

Urinary metabolites of ^{75}Se were studied in male Holtzman rats fed a Torula yeast diet with either no selenium (basal) or 0.5 ppM selenium (selenium) added as sodium selenite. The animals were anesthetized, a ureter was cannulated, and 20 muCi of $^{75}SeO_3^{=}$ were injected intraportally. Only a small fraction (1.3 percent) of the injected ^{75}Se was excreted in 6 h by animals fed the basal diet but 13.3 percent was excreted by animals fed the selenium diet. Paper chromatography showed that both groups excreted mostly inorganic ^{75}Se in the first 10 min. A decrease in ^{75}Se excretion followed, and then, 70 min after the collection was started, the selenium diet group had an increase in ^{75}Se excretion which persisted for the rest of the 6 h and consisted mainly of the organic metabolites trimethylselenonium ion and U-2. ^{75}Se excretion remained low in the basal diet group. Liver uptake and release of ^{75}Se in the 1 h following intraperitoneal $^{75}SeO_3^{=}$ injection was much greater in the selenium diet rats than in the basal diet rats. These results suggest that the greater excretion of ^{75}Se by rats fed the selenium diet than that by rats fed the basal diet was due to increased production of organic urinary selenium metabolites by the liver. (auth)

14624 APPLICATION OF COMPUTERS FOR HEURISTICS AND SIMULATION OF TRANSPORT OF RADIONUCLIDES. Kindler, E. (Charles Univ., Prague). pp 145-148 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The application of computers for modeling and simulation in radionuclide kinetics studies is discussed. The development of software which makes the computer accessable to all members of the research team is emphasized. (ERB)

14625 CRYPTATING AGENT (HEXAOXADIAMIN MACROBICYCLE) IN EXPERIMENTAL THERAPY OF INTERNAL CONTAMINATION. Knajfl, J.; Smid, A. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). pp 155-157 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

The influence of the cryptating agent on the retention of ^{85}Sr, ^{140}Ba, and ^{210}Pb in mice following intraperitoneal injection was determined. In all cases, the cryptating agent decreased the retention of the radioisotope in the mice as measured by whole-body counting 8 days following injection. (ERB)

14626 EVALUATION OF THE RETENTION OF RADIUM-224 AND SOME DAUGHTER PRODUCTS IN MICE AFTER REPEATED ADMINISTRATION. Malatova, I. (Inst. of Hygiene and Epidemiology, Prague); Dvorak, V. pp 181-190 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Radium-224 retention values were determined for the skeleton and the whole body of mice after eleven administrations. The calculations confirm the possibility of applying retention functions from single-administration experiments to the evaluation of results involving multiple administrations. The results of the in vivo measurements accentuate the necessity of following the kinetic parameters over a prolonged period in evaluating age and exposure dependence. (ERB)

14627 DOSE DISTRIBUTION IN BONE MARROW OF RAT FROM ^{89}Sr. Neruda, O.; Chorvat, D. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 199-204 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

A single intravenous injection of 100 μCi of ^{89}Sr was administered to female Wistar rats. At various times (1, 3, 7, 14, 40, and 60 days) after administration the rats were killed and the dose rate distribution over individual bones was determined. The mean dose rate in the whole bone marrow was then calculated. A correlation was found between whole bone activity and bone marrow activity. The mean, maximum, and minimum dose rates in whole bone marrow for the given time periods are presented in tabular form. (ERB)

14628 DETERMINATION OF THE EXHALED AMOUNT OF ^{220}Rn(Tn). Pifflova, L.; Babicka, J. (Inst. of Hygiene and Epidemiology, Prague). pp 231-236 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

A method utilizing a flow precipitation chamber was applied to the detection of exhaled thoron (Tn) in mice. The released fraction Tn $(1-\alpha) = 0.33$ from standard ^{228}Th solution was ascertained in calibration measurements under conditions of bubbling at a constant flow rate of 1.6l/min. at room temperature. Furthermore the effectiveness of precipitation ($\epsilon = 0.098$) of the chamber was determined at 1.5 kV and the bottom limit of detection (4 pCi Tn/l) was determined at a flow rate of 5l/min. The exhaled fraction of Tn in mice was practically constant for a period of at least 3 weeks and amounted to 30 to 40% of the total Tn production in the body. (ERB)

14629 ZIRCONIUM COMPOUNDS IN THE THERAPY OF INTERNAL CONTAMINATION. Severa, J. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). pp 257-262 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The influence of zirconium citrate, administered orally, on the absorption of ^{144}Ce administered intravenously at different pH levels was studied in albino rats. It was found that the whole body and organ retention of ^{144}Ce was dependent upon the pH of the administered solution. The influence of zirconium citrate on ^{144}Ce retention was greatest when the two were administered simultaneously. A significant decrease in ^{144}Ce retention in liver and kidneys was also found if the zirconium citrate was administered 30 min. after ^{144}Ce application. (ERB)

14630 SUBCELLULAR KINETICS OF HEPATOTROPIC RADIONUCLIDES IN LIVER. Slouka, V.; Hradil, J. (Charles Univ., Prague). pp 263-269 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The subcellular distribution of radiocerium and radioyttrium in monomeric and polymeric forms has been studied in rat livers at seven intervals from 4 hours up to 28 days following intravenous injection. The highest early uptake of monomeric Ce was in the soluble fraction with a gradual transfer to the mitochondrial and microsomal fractions. The distribution pattern and kinetics of polymeric forms of Ce and Y were different, with a highest early uptake in the nuclear fraction. Using the COMANSI programme, a 3-compartment open model was chosen and the system was solved by means of a digital computer. Calculated values corresponded well with the experimental data. (auth)

14631 QUANTITATIVE AUTORADIOGRAPHY ON DIELECTRIC FOILS. Thomas, J.; Machek, J.; Hanzlík, J.; Sedlak, A. (Inst. of Hygiene and Epidemiology, Prague). pp 323-328 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Autoradiography on dielectric foils is used in studies of the microdistribution of activities and doses. A quantitative method is described that can be used to determine the microdistribution of the dose from radium in the bones of mice. Theoretical as well as experimental considerations are discussed. (ERB)

14632 INVESTIGATION OF ^{131}I IN THE CATTLE THYROID GLAND. Zavadsky, M.; Cechova, J. (Inst. of Work Hygiene in the Uranium Industry, Kamenna, Czech.). pp 336-338 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

A radiochemical method for determining the ^{131}I content of the thyroid gland of cattle is described. Using the described method, the ^{131}I content of the thyroid gland of cattle from the vicinity of a nuclear power plant was determined and compared to that of control cattle. The results of the study confirm the fact that the method is sufficiently sensitive to be used as an indicator of environmental contamination by ^{131}I. (ERB)

14633 TRANSFER OF RADIOACTIVE MATERIAL BETWEEN ELECTRICALLY COUPLED NEURONS OF THE LEECH CENTRAL NERVOUS SYSTEM. Rieske, E.; Schubert, P.; Kreutzberg, G. W. (Max Planck Inst. for Psychiatry, Munich). Brain Res.; 84: No. 3, 365-383(Feb 1974).

Intracellular application of tritiated precursors by means of microiontophoresis was performed on nerve cells in isolated segmental ganglia of the leech ventral nerve cord. Incorporation as well as intra- and interneuronal transport were studied by autoradiography after injection of fucose, glucosamine, glycine, leucine, orotic acid, and uridine. Within several minutes of intraneuronal injection, the precursors were incorporated into macromolecules. Fucose and glucosamine injection resulted in the most extended labeling of the nerve cell processes, indicating a transport rate of about 11 mm/day. When the radiochemicals were injected into one of the two electrically coupled giant nerve cells — the so-called Retzius cells (Rc) — a specific labeling not only of the injected Rc but also of the coupled but not injected Rc was found. Injection of protein or glycoprotein precursors into one Rc produced heavy labeling of both Rcs including their processes. With orotic acid and uridine this interneuronal transfer was confined to the electrically coupled Rc twin. Intracellular injection of one Rc with puromycin followed by injection of amino

acids or fucose into the same Rc or into the coupled Rc resulted in an inhibition of precursor incorporation within the puromycin-injected Rc and an exclusive labeling of the coupled Rc, thus indicating that the precursors themselves were transferred. It is suggested that after microiontophoretic application an interneuronal transfer of relatively low molecular weight material takes place, probably across the low-resistance junction through which the Rcs are electrically coupled. (NL)

14634 TRANSFER OF LEAD THROUGH THE RATS INTESTINAL WALL. Gruden, N.; Stantic, M. (Inst. for Medical Research, Zagreb). Sci. Total Environ.; 3: No. 3, 288-292(Jan 1975).

The transfer of ^{203}Pb through the wall of the duodenum, jejunum, and ileum in 6- and 26-week old female albino rats was studied by the in vitro method of everted sacs. The lead transport through and the lead uptake in the wall were practically the same in all intestinal segments. The influence of age on these parameters of lead metabolism was not observed by the method used. It seems that the active transport of lead in all segments of the small intestine in 6-weeks old rats is negligible. (NL)

14635 EFFECT OF THYROID STATUS AND THIOCYANATE ON ABSORPTION AND EXCRETION OF IODINE BY CATTLE. Miller, J. K.; Moss, B. R.; Swanson, E. W.; Lyke, W. A. (Comparative Animal Research Lab., Oak Ridge, TN). Contract AT(40-1)-Gen-242. J. Dairy Sci.; 58: No. 4, 526-531(Apr 1975).

Effects of thyroidectomy or iodine-131, thyroprotein feeding, and thiocyanate dosing on radioiodine metabolism in the bovine were studied in 34 animals. Two thyroidectomized calves excreted 44 percent more radioiodine in urine and 38 percent less in feces than two thyroid-intact calves. Oral thiocyanate increased urinary radioiodine 32 percent in thyroidectomized and 46 percent in intact calves while reducing fecal radioiodine 48 percent in thyroidectomized and 11 percent in intact calves. Urinary radioiodine clearance of two heifers was increased 52 percent by thiocyanate, but urine flow was not affected. Percentages of radioiodine doses cycled through the abomasum daily and recovered from digestive tracts at slaughter, respectively, were: 12 thyroid-intact cows, 468 and 77; two intact cows fed 10 g sodium thiocyanate daily, 64 and 41; 10 thyroid-damaged cows, 506 and 149; and four thyroid-damaged cows fed 8 g thyroprotein daily, 372 and 93. Thyroid damage had little effect on gastric radioiodine secretion but increased total digestive tract radioiodine because of greater volume of tract contents. Inhibition of gastric radioiodine secretion by thiocyanate reduced the digestive tract radioiodine pool. The digestive tract iodine pool may conserve iodine by reducing loss in urine. (auth)

14636 ALTERING IODINE METABOLISM IN THE CALF BY FEEDING IODINE-BINDING AGENTS. Miller, J. K.; Swanson, E. W.; Lyke, W. A.; Byrne, W. F. (Univ. of Tennessee, Knoxville). Contract AT(40-1)-Gen-242. J. Dairy Sci.; 58: No. 6, 931-937 (Jun 1975).

Effects of feeding cottonseed meal and anion-exchange resin on iodine absorption and excretion by calves were investigated. Each additional amount of resin fed from .3 to 3.5 g/kg body weight further increased fecal excretion from single oral iodine-131 and intravenous iodine-125 doses. By feeding 3 to 10 g cottonseed meal/kg body weight, excretion of oral iodine-131 given daily was increased 7 to 94 percent in feces and reduced as much as 35 percent in urine, but plasma iodine-131 was not changed. Introducing 1 g resin/kg body weight daily into the diet increased fecal iodine-131 excretion three to five times that with cottonseed meal alone and reduced both plasma and urinary iodine-131. The same amount of resin fed daily had similar effects on excretion of iodine-131 injected subcutaneously each day. Although iodine depletion by a highly efficient iodine binder (resin) in the gastrointestinal tract is probable, iodine binding by a natural feed constituent (cottonseed meal) was relatively inefficient. (auth)

14637 ENZYMATIC SYNTHESIS AND ORGAN DISTRIBUTION STUDIES WITH ^{13}N-LABELED L-GLUTAMINE AND L-GLUTAMIC ACID. Gelbard, A. S.; Clarke, L. P.; McDonald, J. M.; Mohahan, W. G.; Tilbury, R. S.; Kuo, T. Y. T.; Laughlin, J. S. (Sloan-Kettering Cancer Center, New York). Radiology; 116: No. 1, 127-132(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (1 Dec 1974).

A method was developed for producing several hundred mCi of $^{13}NH_3$ with subsequent enzymatic synthesis of large amounts of ^{13}N-labeled glutamine and glutamic acid. Dynamic measurements and quantitative whole body scans demonstrated greater glutamine uptake in the liver region of mongrel dogs than uptake of glutamic acid of NH_3, although all concentrated in the liver to a significant degree. Myocardial uptake of glutamine and glutamic acid was low, while NH_3 was incorporated into the heart, brain, bladder, and kidneys at a greater rate than the amino acids. (auth)

14638 DISTRIBUTION OF INJECTED ^{85}Sr IN TISSUES AND BONES OF GROWING PIGS. Krusemark, L. L.; Boomgaardt, J.; Harmon, B. G.; Anderson, J. J. B. (Univ. of Illinois, Urbana). J. Anim. Sci.; 39: No. 2, 331-334(Aug 1974).

The effect of time on the distribution and retention of intravenously injected ^{85}Sr was studied in 16 crossbred pigs. Specific activity decreased rapidly in serum, kidney, liver, and longissimus muscle. Metatarsal, turbinate, 10th rib, and fibula had similar specific activities at each time determined, reaching peaks at 16 or 32 hr post injection. The specific activity of the proximal and distal portions of the femur was maximal at 4 and 16 hr., respectively, whereas specific activity of the shaft showed linear increase through the 128-hr period and was less than the other bone samples. These activity changes for femur ends and shaft reflect the greater metabolic activity in the areas of the epiphyseal cartilage than in the diaphysis. Turbinate ^{85}Sr uptake relative to other bones was less than reported in ^{45}Ca uptake studies. Considering the bones sampled in the present experiment, the proximal portion of the femur appears to be the site of maximum metabolic activity in the skeleton of the young pig. In this experiment both the distribution and retention of ^{85}Sr were time dependent and appeared to reflect the normal physiological growth process. (auth)

14639 VARIABILITY OF ^{109}Cd UPTAKE IN RATS AS AFFECTED BY ROUTE OF ADMINISTRATION AND MANNER OF EXPRESSING RESULTS. Ithakissios, D. S.; Kessler, W. V.; Arvesen, J. N.; Born, G. S. (Purdue Univ., West Lafayette, IN). Bull. Environ. Contam. Toxicol.; 12: No. 3, 281-288(Sep 1974).

Under the conditions of this experiment, variability in the cadmium content of liver and kidney, as measured by the coefficient of variation, was the same for both intraperitoneal and intravenous injection. For spleen, intravenous injection gave less variability. For liver, where cadmium uptake was large, variability was less when uptake for the whole organ rather than per gram of organ was used. For kidney and spleen, there was no difference in variability for the two ways of expressing the results. (auth)

Microorganisms

14640 INTERESTING BIOLOGICAL PHENOMENON IN URANIUM MINES. Adamek, M. (Okresni Ustav Narodnikho Zdravi, Prague). Rudy (Prague); 22: No. 8, 232-234(Aug 1974). (In Czech).

Metabolic sorption of radionuclides was studied in the biomass of moulds occurring in a number of some two hundred strains in the mine environment. The results of radiometric analysis are listed and autoradiograms are presented of several mould strains of the Aspergillus genus. The strains were incubated in the Czapek-Dox culture medium to which either the gravitational sediment collected in uranium mines or uranyl nitrate or uranyl acetate were added. High values of absorbed radioactivity were observed as was a capacity in respective strains of lower moulds of sorbing radionuclides not only in the biomass but also in the spores. (INIS)

New Tracer Techniques

Refer also to abstracts 13744, 13781, 14622, and 14637.

14641 (IRI-133-74-03) INFLUENCE OF COMPLEXING AGENTS ON THE ACCUMULATION OF ZINC IN THE PANCREAS OF THE RAT. Stortenbeek, A. J.; van den Hamer, C. J. A. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1974. 11p. (In Dutch).

The possible influence of different ligands on the transport of zinc through membranes of rat pancreas and liver cells was studied. Zn-EDTA was stable in blood serum, whereas both zinc phenanthrolinate and zinc glycinate were unstable. Neither of the complexes showed a specific affinity for pancreas cells. (NL)

14642 (JUL-1135-RA) CONVERSION OF ORGANIC SUBSTANCES WITHIN THE SOIL, UPTAKE OF ORGANIC COMPOUNDS BY PLANT ROOTS, AND ABSORPTION, TRANSLOCATION AND REMOBILIZATION OF CALCIUM IN TREES. Scientific Works from 1962–1974. Fuehr, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Arbeitsgruppe Radioagronomie). Nov 1974. 36p. (In German). INIS.

The disintegration of ^{14}C-labelled substances in soils and the uptake of organic compounds of the soil by plant roots and research work done in the program of research and development of the Kernforschungsanlage Juelich GmbH are described. (GE)

14643 (MBL-1974-10) EFFECT OF ATROPINE AND METHYLATROPINE ON THE SWEAT SECRETION OF UNRESTRAINED MICE MEASURED WITH RADIOACTIVE SALINE. van Eick, A. J.; Bock, J. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 11p.

Effect of drugs on the natural sweat secretion from the feet of free-moving mice was determined. Mice injected with labelled saline were allowed to move freely on filterpaper. The amount of radioactivity found in the paper is a measure of the sweat produced. The filterpaper was impregnated with bromphenol blue in order to detect contamination by other excreta than sweat. A quaternary derivative of atropine was found to diminish the excretion of radioactive material more than its tertiary analogue. (NL)

14644 (N-75-10695) SKELETAL STATUS AND SOFT TISSUE COMPOSITION IN ASTRONAUTS. Tissue and Fluid Changes by Radionuclide Absorptiometry In Vivo. Annual Progress Report, 15 July 1972–15 July 1973. Cameron, J. R.; Mazess, R. B.; Wilson, C. R. (Wisconsin Univ., Madison (USA). Bone Mineral Lab.). 1 Aug 1973. Contract AT(11-1)-1422. 153p. (NASA-CR-140689). NTIS $6.25.

A device has been constructed and tested which provides immediate readout of bone mineral content and bone width from absorptiometric scans with low energy radionuclides. The basis of this analog system is a logarithmic converter-integrator coupled with a precision linear ratemeter. The system provided accurate and reliable results on standards and ashed bone sections. Clinical measurements were made on about 100 patients with the direct readout system, and these were highly correlated with the results from digital scan data on the same patients. The direct readout system has been used successfully in field studies and surveys as well as for clinical observations. (auth)

14645 (N-75-10696) SKELETAL STATUS AND SOFT TISSUE COMPOSITION IN ASTRONAUTS. Tissue and Fluid Changes by Radionuclide Absorptiometry In Vivo. Annual Progress Report, 15 July 1973–15 July 1974. Cameron, J. R.; Mazess, R. B.; Wilson, C. R. (Wisconsin Univ., Madison (USA). Bone Mineral Lab.). 1 Aug 1974. Contract AT(11-1)-1422. 154p. (NASA-CR-140703). NTIS $6.25.

Research on the measurement of bone mineral content and body composition ranges from isotopic tracer methods and the adoption of clinical standards to osteoporosis therapy and the effects of nutritional factors on bone loss. (STAR)

14646 XENON-133 WASHOUT FOR MEASURING INTRARENAL BLOOD FLOW IN THE MICROPUNCTURE RAT. Kinney, M. J.; Quinones, J.; Rudich, S.; DiScala, V. (Public Health Service Hospital, Staten Island, NY). Am. J. Physiol.; 227: No. 3, 657-664 (Sep 1974).

Repeated ^{133}Xe-washout curves of renal blood flow and distribution can be obtained easily if retrograde femoral artery catheterization of the aorta and a lead kidney cup are added to the standard micropuncture (MP) preparation of the rat. Each such study need be only 6 min. Mean cortical blood flow distribution (Ao^i) of 13 micropuncture rats (36 studies) was 69 percent (SE equals 1.7, SD equals 10). Individual rats were reproducible in any one study with an SD of less than 6; however, the range was 47 to 81 percent. Mean outer cortical flow (F^i) was 3.5 ml/min per g (SE equals 0.4, SD equals 1.5). Autoradiographs and postnephrectomy studies verified the distribution and source of the radioactivity. Mean total blood flow (Fo) correlated well with total flow determined by the clearance of PAH or an electromagnetic flow probe. Studies in dogs corroborated the reproducibility of Ao^i in any one series of washout studies and significant variation in Ao^i between animals or studies of the same dog kidney on different days. (auth)

14647 RADIOIMMUNOASSAY OF SERUM TRIIODOTHYRONINE ON SMALL, REUSABLE SEPHADEX COLUMNS. Alexander, N. M.; Jennings, J. F. (Univ. of California School of Medicine, San Diego). Clin. Chem.; 20: No. 10, 1353-1361(Oct 1974).

A radioimmunoassay was developed for serum T_3 using small, reusable Sephadex G-25 columns. The procedure offers the advantages that, on a single column, T_3 is quantitatively extracted from serum that is premixed with ^{125}I-labeled T_3, serum proteins are removed, binding with antiserum is accomplished in 1 hour, and the free and bound T_3 are separated. The mean value for between-assay analysis over a period of 12 days was 94 ± 8.5 (SD) ng/dl. Thus the work supports a mean T_3 concentration of 90 to 100 ng/dl in serum from euthyroid individuals. (ERB)

14648 VALIDATION OF A DUAL-ISOTOPE PLASMA RATIO METHOD FOR MEASUREMENT OF CHOLESTEROL ABSORPTION IN RATS. Zilversmit, D. B.; Hughes, L. B. (Cornell Univ., Ithaca, NY). J. Lipid Res.; 15: No. 5, 465-473(Sep 1974).

Several methods for measuring cholesterol absorption in the rat have been compared. After administration of an oral dose of labeled cholesterol (^{14}C or ^{3}H) and an intravenous dose of colloidal labeled cholesterol (^{3}H or ^{14}C) the ratio of the two labels in plasma or whole blood 48 hr or more after dosing compared closely to the ratio of areas under the respective specific activity-time curves. The area ratio method is independent of a time lag between the appearance of oral and intravenous label in the bloodstream. Both measures of cholesterol absorption agree fairly well with a method based on measuring the unabsorbed dietary cholesterol in a pooled fecal sample. The plasma isotope ratio method gave more reproducible results than the fecal collection method when the measurement was repeated in the same animals 5 days after the first measurement. Cholesterol absorption was overestimated by the use of Tween 20-solubilized labeled cholesterol for the intravenous dose. The plasma disappearance curves of injected labeled colloidal cholesterol and cholesterol-labeled chylomicrons infused intravenously over a 3.5-h period in the same animal coincided within experimental error from the first day until 75 days after injection. The plasma isotope ratio method for cholesterol absorption gave the same results in rats practicing coprophagy as in those in which this practice was prevented. The addition of sulfaguanidine to the diet lowered cholesterol absorption as measured by the plasma isotope ratio to the same degree as that measured by the fecal collection method. (auth)

14649 CELL-MEDIATED IMMUNITY TO HERPES SIMPLEX IN HUMANS: LYMPHOCYTE CYTOTOXICITY MEASURED BY ^{51}Cr RELEASE FROM INFECTED CELLS. Russell, A. S.; Percy, J. S.; Kovithavongs, T. (Univ. of Alberta, Edmonton). Infect. Immun.; 11: No. 2, 355-359(Feb 1975).

We assessed cell-mediated immunity to herpes simplex virus type 1 antigen in patients suffering from recurrent cold sores and in a series of healthy controls. Paradoxically, all those subject to recurrent herpetic infections had, without exception, evidence of cell-mediated immunity to herpes antigens. This was demonstrated by lymphocyte transformation and specific ^{51}Cr release from infected human amnion cells after incubation with peripheral blood mononuclear cells. Where performed, skin tests with herpes antigen were also positive. In addition, serum from these patients specifically sensitized herpesvirus-infected cells to killing by nonimmune, control mononuclear cells. These tests were negative in the control patients except in a few cases, and it is suggested that these latter may be the asymptomatic herpesvirus carriers previously recognized or that they may have experienced a genital infection. (auth)

14650 CONVERSION OF THYROXINE (T4) AND TRIIODOTHYRONINE (T3) AND THE SUBCELLULAR LOCALIZATION OF THE CONVERTING ENZYME. Hesch, R. D.; Brunner, G.; Soeling, H. D. (Univ., Goettingen, Ger.). Clin. Chim. Acta; 59: No. 2, 209-213(10 Mar 1975).

Direct radioimmunoassay of T3 was used to measure the formation of T3 by deiodination of T4. Results demonstrated that T4 is converted to T3 by the intact liver and by isolated liver cells. The conversion takes place in the microsomal fraction of homogenized liver. (NL)

14651 RADIOIMMUNOASSAY OF HUMAN PLASMA APOLIPOPROTEINS. I. Assay of Apolipoprotein-β. Bautovich, G. J.; Simons, L. A.; Williams, P. F.; Turtle, J. R. (Univ. of Sydney). Atherosclerosis.; 21: No. 2, 217-234(Mar 1975).

A specific radioimmunoassay for apolipoprotein-B, the dominant apoprotein of human plasma β-lipoprotein, is described. The antigen for the assay was a narrow-density subclass of β-lipoprotein (density 1.020 to 1.050), labelled with ^{125}I, and the antibody was produced by immunization of the rabbit. Bound and free fractions were separated using a double antibody precipitation technique. The absolute lower limit of sensitivity was approximately 5 ng protein, with a working range of from 10 to 200 ng. Dilutions of plasma and various lipoprotein fractions displaced labelled β-lipoprotein in a parallel fashion to the standard curve, demonstrating specificity of the assay for apo-B. There was limited cross-reactivity with monkey serum. Apoprotein-B was undetectable in a β-lipoproteinaemia serum. Mean plasma apo-B concentration (± I S.D.) in healthy subjects was 90 ± 24 mg/100 ml, with a positively skewed distribution. Concentrations of apo-B were increased in all types of hyperlipoproteinaemia. There was a significant positive correlation between plasma apo-B and plasma cholesterol concentrations. In health, 94% of total plasma apo-B was confined to β-lipoprotein but there was a shift to pre-β-lipoprotein in hypertriglyceridaemia. (NL)

14652 QUANTITATIVE IMMUNOAUTORADIOGRAPHY AT THE CELLULAR LEVEL. I. Design of a Microphotometric Method to Quantitate Membrane Antigens on Single Cells Using ^{125}I-Labeled Antibodies. Thiel, E.; Doermer, P.; Rodt, H.; Thierfelder, S. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). J. Immunol. Methods; 6: No. 4, 317-330 (Feb 1975).

Microphotometry of grain density was applied to nucleated cells with ^{125}I-labelled membranes. Geometric and absorption factors of radiation were investigated in order to find suitable conditions for quantitative evaluation. A preparatory device is given and a set-up of appropriate measuring conditions is presented. With these prerequisites the reflected-light bright-field photometry of immunoautoradiographs permits to determine automatically the content of surface antigens of single cells. Measurement examples are demonstrated. (NL)

14653 COMPARISON OF RESULTS USING THREE COMMERICALLY AVAILABLE VITAMIN B-12 RADIOASSAY KITS. Kampa, I. S.; Hundertmark, J. M. (The Valley Hospital, Ridgewood, NJ). Clin. Chim. Acta; 59: No. 2, 191-194(10 Mar 1975).

Vitamin B-12 levels in human serum samples were measured with three commercially available radioassay kits. All three kits produced acceptable reproducibility. The major difference between the procedures was the ease of performing the test. (NL)

14654 CONTRIBUTION TO GASTROINTESTINAL TRACT CANCER DIAGNOSIS BY ENDOSCOPIC AIMED RADIOISOTOPE SCANNING. di Matteo, S.; Bigotti, A.; Casale, V.; Crespi, M. (Regina Elena Inst. for Cancer Research, Rome). pp 278-282 of Cancer Detection and Prevention. Maltoni, C. (ed.). Amsterdam; Excerpta Medica (1974).

From second international symposium on cancer detection and prevention; Bologna, Italy (9 Apr 1973).

A miniaturized solid state detector is connected to a fiber endoscope and is used to detect increased phosphorus-32 uptake in tissue, containing neoplasms in the gastrointestinal tract. The device can also be used to determine the outline of tissue containing malignant cells. (NL)

14655 EVALUATION OF SPECIFIC ANTIBODIES IN HUMAN SERA BY A CEA ANTIGEN ISOLATED WITH A MODIFIED METHOD. Sega, E.; Kisabella, F.; Crespi, M.; Citro, G. (Regina Elena Inst. for Cancer Research, Rome). pp 621-626 of Cancer Detection and Prevention. Maltoni, C. (ed.). Amsterdam; Excerpta Medica (1974).

From second international symposium on cancer detection and prevention; Bologna, Italy (9 Apr 1973).

Repeated gel filtration and chromatography were employed to obtain ultrapure fractions of iodine-125-labeled CEA. Attempts were also undertaken to purify CEA by immunological means. It is not possible to discriminate between sera of patients with carcinoma and healthy persons on the basis of the CEA antibody titer. (NL)

14656 COMPETITIVE PROTEIN-BINDING AND RADIOIMMUNOASSAY OF VITAMIN B12 IN SERUM. van der Wiel, D. F. M. Groningen, Netherlands; Rijksuniversiteit (1974). 105p.

Thesis.

Three methods for the measurement of vitamin B12 by means of saturation have been investigated. The pooled serum method is based on pooled human serum as the source of binding protein. Separation of free from bound vitamin B12 is obtained by adsorption of the bound vitamin to DEAE-cellulose, followed by filtration. The unknown serum is extracted with glutamic acid pH 4.3 by which procedure centrifugation is avoided. In the bacteria method, vitamin B12 is bound by a protein from the cell wall of Lactobacillus leichmannii. The intact bacteria are used as solid phase. Separation of free from bound vitamin is obtained by filtration in a disposable syringe. The antibody method is the first radioimmunoassay of vitamin B12 that has been reported. Antibodies were purified by rivanol and identified by polyacrylamide gel electrophoresis. Affinity chromatography proved to be a useful method for purification of the antibodies. (NL)

14657 ISOLATION AND CHARACTERIZATION OF HIGHLY LABELED RIBOSOMAL RNA FROM HUMAN LEUKEMIC CELLS. Seeber, S.; Schmidt, C. (Essen Univ., (Gesamthochschule)). pp 298-301 of Characterization of Human Tumours. Maltoni, C. (ed.). Amsterdam; Excerpta Medica (1974).

From fifth international symposium on the biological characterization of human tumours; Bologna, Italy (4 Apr 1973).

Labeling with high specific activity ^{32}P-orthophosphate, nucleotide analysis, and the determination of oligonucleotide frequencies have been employed in order to compare the primary structures of ribosomal 28 S RNA of acute myelocytic leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, leukemic lymphosarcoma, and Burkitt lymphoma cells. Minor differences have been detected but it is not clear as to whether they reflect differences in precursor pools or whether they are due to some heterogeneity in the 28 S r-RNA fractions isolated, or whether they represent microheterogeneity within the sequences between the different cell lines. (NL)

14658 RADIOIMMUNOASSAY OF HUMAN HIGH DENSITY LIPOPROTEIN APOPROTEIN A-1. Fainaru, M.; Glangeaud, M. C.; Eisenberg, S. (Hadassah Univ. Hospital, Jerusalem). Biochim. Biophys. Acta; 386: No. 2, 432-443(Apr 1975).

A double antibody radioimmunoassay technique was developed for the measurement of apolipoprotein A-I, the major apoprotein of human high density lipoprotein. Apolipoprotein A-I was prepared from human delipidated high density lipoprotein (d = 1.085 to 1.210) by gel filtration and ion exchange chromatography. Purified apolipoprotein A-I antibodies were obtained by means of apolipoprotein A-I immunoadsorbent. Apolipoprotein A-I was radiolabeled with ^{125}I by the iodine monochloride technique. From 65 to 80% of the ^{125}I-labeled apolipoprotein A-I could be bound by the different apolipoprotein A-I antibodies, and more than 95% of the ^{125}I-labeled apolipoprotein A-I was displaced by unlabeled apolipoprotein A-I. The immunoassay was found to be sensitive for the detection of about 10 ng of apolipoprotein A-I in the incubation mixture, and accurate with a variability of only 3 to 5% (S.E.M.). This technique enables the quantitation of apolipoprotein A-I in whole plasma or high density lipoprotein without the need of delipidation. The quantitation of apolipoprotein A-I in high density lipoprotein was found similar to that obtained by gel filtration technique. (NL)

14659 SOLID PHASE RADIOIMMUNOASSAY FOR URINE ALDOSTERONE USING ANTIBODIES LINKED TO NYLON NETS. Schaefer, A. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg); Faulstich, H.; Vecsei, P.; Hobler, H. FEBS (Fed. Eur. Biochem. Soc.) Lett.; 48: No. 2, 230-234(Nov 1974).

Sheep serum protein against 21-aldosterone-hemisuccinate were conjugated to surfaces of nylon nets. The nylon surfaces were activated with minimum damage to the biospecific properties of the proteins. The nylon nets proved most sensitive for the valuation of aldosterone in a solid phase radioimmunoassay. They also extracted the steroid specifically from aqueous solutions. (NL)

14660 RAPID DETERMINATION OF THE SPECIFIC RADIOACTIVITIES OF RNA PRECURSOR POOLS (UTP and ATP) BY AN ENZYMIC METHOD. Wiegers, U.; Klapproth, K.; Hilz, H. (Univ., Hamburg). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 47: No. 2, 307-313(Oct 1974).

In order to obtain information on the synthetic pattern of RNA and DNA with radioactive precursors, knowledge of the correlation of the precursors prove specific radioactivities with the labelling of nucleic acids is essential. The determination of ATP specific radioactivity and an improved method for an analogous analysis of UTP, using enzymic displacement, for selective quantitation of the radioactive label is described. (NL)

14661 CHANGES IN ^{35}S-METHIONINE INCORPORATION INTO PROTEIN OF THE RAT BRAIN DURING PUBERTY. ter Haar, M. B.; Mackinnon, P. C. B. (Oxford Univ.). Brain Res.; 85: No. 3, 535-538(Mar 1975).

The incorporation of (^{35}S)-methionine into protein in discrete parts of the hypothalamus and the amygdale relative to that in the putamen has been measured in male, female, and neonatally-androgenized female rats over the time of puberty. Relative values were employed to provide an internal control which would compensate for the steadily declining levels of methionine incorporation in the rat brain during puberty. The results support previous evidence which has indicated the development of the hypothalamus during puberty, together with a possible role played by the amygdala, bringing about the initiation of cyclicity in the female. Further investigations, using high-resolution autoradiography, have also indicated that the medial and basomedial nuclei are those responsible for the specific increase in methionine incorporation in the amygdala of the female rats. (NL)

14662 EFFECTS OF STEROID COMPETITION AND TIME ON THE UPTAKE OF ^{3}H-CORTICOSTERONE IN THE RAT BRAIN; AN AUTORADIOGRAPHIC STUDY. Rhees, R. W.; Grosser, B. I.; Stevens, W. (Univ. of Utah, Salt Lake City). Brain Res.; 83: No. 2, 293-300(Jan 1975).

The localization of (^{3}H)corticosterone in the brain and pituitary of the adrenalectomized rat was studied by autoradiography. Corticosterone was concentrated preferentially by neurons in the hippocampus, septum, amygdala, and neocortex, with the hippocampal and septal neurons having the greatest concentration. The (^{3}H)corticosterone localization was significantly greater in neurons from adrenalectomized animals. Administration of unlabeled corticosterone (3 mg) 30 min before injection with (^{3}H)corticosterone significantly decreased cellular localization of the labeled corticosterone, whereas (^{3}H)corticosterone localization was not affected by progesterone pretreatment. Animals were sacrificed 15, 30, and 120 min after the injection of (^{3}H)corticosterone to study the distribution of the hormone

over the cytoplasm and nuclei. Silver grains were localized primarily over the cytoplasm of the concentrating neurous 15 min after injection; however, by 30 min after injection they were evenly distributed over both nuclei and cytoplasm. (NL)

14663 TRITIUM LABELING OF LUTEINIZING HORMONE BY REDUCTIVE METHYLATION. Ascoli, M.; Puett, D. (Vanderbilt Univ., Nashville). Biochim. Biophys. Acta; 371: No. 1, 203-210(5 Nov 1974).

High specific activity $B^3H_4^-$ (ca. 5Ci/mmole) is used in the reductive ^{3}H-methylation of a glycoprotein hormone. Ovine pituitary luteinizing hormone was labelled to give a specific activity of 650 μCi/mg. The reaction was highly specific for lysine and about 85% of the protein lysyl residues were modified with dimethyl lysine as the major derivative. The potency of the tritiated gonadotropin was not reduced relative to the unlabelled hormone as determined by both in vivo and in vitro bioassays. Intravenous injection 1.6 μg of ^{3}H-labelled luteinizing hormone into mature male rats showed that most of the radioactivity (ca. 90%) is cleared from circulation with an apparent half-life of 5 min; however, there is a component with an apparent half-life greater than one day. The incubation of 20 ng of ^{3}H-labelled luteinizing hormone with decapsulated rat testis increased the testicular levels of adenosine 3',5'-cyclic monophosphate; a maximum value occurred in about 30 min., and there was a return to basal levels in about 3 h. In contrast the stimulation of steroidogenesis continuously increased with time, at least up to 4 h. Thus, the tritiated gonadotropin is suitable for both metabolic and mechanism-of-action studies. An apparatus for reductive ^{3}H-methylation is pictured and described. (NL)

14664 APPARATUS FOR RADIOIMMUNOASSAY AND RADIOASSAYS, APPLYING THE SURFACE-COATED ANTIBODY TECHNIQUE. (to Philips Gloeilampenfabrieken NV). Netherlands Patent 7,205,223/A/. 19 Apr 1972. 12p. (In Dutch).

An apparatus is described with which radioimmunological measurements can be performed. The apparatus consists of a syringe in which the antibodies are coated on a polyurethane sponge; the antigens that are not bound can be removed by emptying the syringe by means of simple movements with the piston. (NL)

14665 STUDIES ON THE SYNTHESIS OF ESTROGEN-SPECIFIC UTERINE PROTEINS. Comparison of Methods of Quantitative Evaluation of Double-Isotope Peaks. Mayol, R. F. (Mead Johnson Research Center, Evansville, IN). Molecular and Cellular Endocrinology; 2: No. 2, 133-146(Jan 1975).

It is demonstrated that under conditions in which the "baseline" incorporation of isotope varies within an experiment, such as in purification or pulse-chase studies, the use of isotope ratios to quantify the data results in erroneous values. In these instances computations using the $\Delta^{14}C$ method described by Mayol and Sinsheimer (1970) provides for what appear to be valid conclusions. However, under conditions in which the baseline incorporation of isotope of the control and experimental groups does not vary, as in studies of the temporal course of synthesis and dose-response relationships, the use of increases in isotope ratios is adequate for quantitative interpretations. (NL)

14666 COMPARISON BETWEEN THE CHANGES IN THE DISTRIBUTION VOLUMES OF INULIN AND ^{51}Cr EDTA AFTER MAJOR SURGERY. Ladegaard-Pedersen, H. J.; Engell, H. C. (Rigshospitalet, Copenhagen). Scand. J. Clin. Lab. Invest.; 35: No. 2, 109-113(Mar 1975).

In 12 patients undergoing major surgery the distribution volumes of inulin (V_I) and (^{51}Cr)EDTA (V_E) were measured simultaneously by a single injection technique the day before and the day after the operation. Preoperatively V_I was correlated to V_E, and both these volumes were correlated to the plasma volume (PV). Postoperatively only the correlation between V_I and PV was found. The changes in V_I and PV were significantly correlated, but there were no correlations between the changes in V_I and V_E or between the changes in these volumes and in the body weight. Inulin seems to be a better tracer than (^{51}Cr)EDTA, but the lack of correlation between the changes in V_I and V_E and the changes in body weight raises some doubts as to the physiological significance of the measured changes. (auth)

14667 IN VIVO LABELLING OF CYTOPLASMIC RNA IN NEURONS OF THE IMMATURE BRAIN CORTEX. Azcurra, J. M. (Buenos Aires Univ. Nacional, Argentina); Carrasco, A. E.; Sellinger, O. Z. Brain Res.; 86: No. 1, 144-149(14 Mar 1975).

A procedure is described for the isolation of the neuronal cytoplasmic RNA. The method was applied for the measurement of the approximate maturation time of its ribosomal RNA component in 8- and 20-day old cerebral cortex perikarya, using tritiated uridine. (NL)

14668 RADIOIMMUNOASSAY FOR MELANOCYTE STIMULATING HORMONE (α-MSH). Goos, H. J. Th. (Univ., Utrecht); Jenks, B. Proc. K. Ned. Adad. Wet., Ser. C; 78: No. 1, 69-72 (1975).

From meeting of the Koninklijke Akademie van Wetenschappen; Amsterdam, Netherlands (28 Sep 1974).

A radioimmunoassay for α-MSH is described. Rabbits, immunized with synthetic α-MSH, produced antibodies that can be used at a dilution of 1:100,000. These antibodies did not show cross-reaction with β-MSH, nor with ACTH. Labelling of α-MSH with ^{125}I was performed according to a modified method of Greenwood et al. as developed by Chard et al. Purification of the label was carried out in two successive steps on Dowex and Sephadex G15, respectively, yielding a label with a specific activity of $\pm$1200 μCi/μg. Sensitivity allows detection of 80 pg MSH/100 μl both in buffer and in human serum. (NL)

14669 IMPRINTING: CORRELATIONS BETWEEN BEHAVIOR AND INCORPORATION OF ^{14}C-URACIL INTO CHICK BRAIN. Bateson, P. P. G. (Cambridge Univ., Eng.). Brain Res.; 84: No. 2, 207-220(Feb 1975).

On the first day after hatching, 106 domestic chicks were injected with (^{14}C) uracil and exposed to a yellow or a red rotating flashing light for 72 min. Shortly before they were killed and 115 min after injection they were given a choice between the two lights. Incorporation of the (^{14}C) uracil into four regions of the brain was measured. Chicks that were active from the early stages of training showed lower rates of incorporation in the midbrain, forebrain base, and anterior roof of the forebrain, than less responsive chicks. When the general lowering effect of behavioral activity on incorporation was eliminated as a source of variation, a striking positive correlation emerged between the preference for the familiar object and incorporation in the anterior forebrain roof. Since preference for the familiar is a direct measure of imprinting and since no other behavioral measure is positively correlated with biochemical changes in anterior roof, it is concluded that these biochemical changes were closely linked with the learning process. (NL)

14670 DIFFERENT RATES TRANSLOCATION OF ^{14}C-L-α-ALANINE (U) AND TRITIATED WATER IN THE XYLEM VESSELS OF TOMATO PLANTS. van Bell, A. J. E. (Rijksuniversiteit, Utrecht). Acta Bot. Neerl.; 23: No. 5/6, 715-722 (Oct 1974).

A solution of ^{14}C-L-α-alanine in tritiated water was allowed to perfuse the xylem vessels of tomato stem segments. In each stem segment an exponential distribution gradient for tritiated water was found, the slope of which was dependent on the length of the stem segment and the perfusion velocity. Nearly all the tritiated water was retained in the stem segment whereas a great amount of ^{14}C-alanine could be recollected. Thus the ^{14}C-alanine was recollected in a solution of other water molecules than those it was introduced in. A similar phenomenon could be observed, if ^{14}C-L-α-alanine or ^{14}C-D-sucrose dissolved in tritiated water were allowed to flow through a Sephadex G-10 column. The results clearly demonstrate, that mass flow in xylem vessels goes along with exchange and diffusion-like processes. Moreover it was shown experimentally that different velocities for the movement of organic solutes and tritiated water in other long-distance translocation systems (sieve tubes) need in no way be in conflict with an assumed longitudinal mass flow of their contents. (NL)

14671 HETEROGENEITY OF PURIFIED HUMAN PITUITARY LUTEINIZING HORMONE: EFFECT ON HORMONE MEASUREMENT BY RADIOIMMUNOASSAY. Benveniste, R.; Frohman, L. A.; Rabinowitz, D. (Hadassah Univ. Hospital, Jerusalem). Endocrinology; 97: No. 1, 20-29(Jul 1975).

Purified preparations of human luteinizing hormone (hLH), Hartree IRC-2, and NIH LER-960, have been examined after gel filtration of unlabelled and iodinated hormone. Several peaks of radioactivity were observed corresponding to dimeric (peak I), monomeric (peak II), and sub-unit (peak III) hLH forms. The immunologic and receptor activities of each fraction have been evaluated. Receptor activity was found in peaks I and II but not in peak III. Within peak II all fractions were not equally active in the receptor assay, and maximum activity appeared to correspond to molecules with elution characteristics similar to the unlabelled molecule. All fractions of peak II were immunologically active when tested against rabbit anti-hCG in excess. Two immunoassay systems with improved specificity for hLH and hLH-alpha, respectively, have been employed to show the presence of alpha subunit in one of the hLH preparations. These data have relevance with respect to testing of immuno and receptor potencies of hLH preparations. (auth)

14672 LOCALIZATION OF LUTEINIZING HORMONE-RELEASING HORMONE IN THE PREOPTIC AREA AND HYPOTHAL-

AMUS OF THE RAT USING RADIOIMMUNOASSAY. Wheaton, J. E.; Krulich, L.; McCann, S. M. (Univ. of Texas Health Science Center, Dallas). Endocrinology; 97: No. 1, 30-38(Jul 1975).

To determine the localization of luteinizing hormone-releasing hormone (LHRH), five brains from adult male rats were serially sectioned in a cryostat at -10°C in either the frontal, horizontal, or sagittal planes. Acetic acid-ethanol extracts of each section were assayed for LHRH using radioimmunoassay (RIA) and in some cases using bioassay as well. Approximately 0.2 ng LHRH was concentrated in medial basal preoptic (MB-PO) tissue overlying the rostral portion of the optic chiasma. This LHRH appears to be associated with the organum vasculosum of the lamina terminalis and/or adjacent neural tissue. Uniform, low levels of LHRH were detected in hypothalamic tissue between the preoptic area (POA) and arcuate-median eminence (ARC-ME) region. In the ARC-ME region, 2.7 ng of LHRH were concentrated primarily in the median eminence. The lateral distribution of LHRH in the ARC-ME region extended beyond the median eminence into tissue corresponding to the lateral aspect of the ventromedial nucleus. Concomitant bioassay and RIA determinations of LHRH were highly correlated. Of the sections bioassayed, only those sections containing LHRH released FSH. These results confirm the presence of LHRH in the POA and in the rostral hypothalamus of the rat brain. The possible significance of LHRH in the POA for the regulation of LH release is discussed. (auth)

14673 RAPID EFFECTS OF SINGLE SMALL DOSES OF L-THYROXINE AND TRIIODO-L-THYRONINE ON GROWTH HORMONE, AS STUDIED IN THE RAT BY RADIOIMMUNOASSAY. Hervas, F.; Morreale de Escobar, G.; Escobar del Rey, F. (Instituto Gregorio Maranon, Madrid). Endocrinology; 97: No. 1, 91-101(Jul 1975).

The effects of thyroid hormone deprivation and restitution on growth hormone (GH) economy have been studied in the rat by means of a specific radioimmunoassay. The pituitary GH content and the plasma GH levels before and during stimulation with pentobarbital ("PB-test") were studied in male rats at different intervals after surgical thyroidectomy ($\overline{T}$), and in $\overline{T}$ rats at different time intervals after the ip injection of 0.20, 1.75, and 5.0 mu g thyroxine (T_4) or 0.05, 0.10, 0.20 and 1.0 mu g triiodothyronine (T_3), all doses being referred to 100 g body wt. Pituitary GH content decreased very rapidly after $\overline{T}$, a difference being shown at the end of the shortest time interval studied (24 h); 24 days after $\overline{T}$, pituitary GH content was 0.3 percent or less of the pre-$\overline{T}$ level, the basal plasma GH was lower than in intact controls and an increase in plasma GH during PB-stimulation was no longer observed. When rats $\overline{T}$ for 30 days or longer were injected with T_4 or T_3, pituitary GH content increased; basal plasma GH levels increased also and a positive response to PB was observed. An effect on pituitary GH content could be observed as soon as 2 h after the ip injection of 1.0 mu g T_3, or 6 h after 5.0 mu g T_4. The "latent period" was somewhat longer when lower doses of the hormones were used. Effects of a single 0.10 mu g T_3 dose could be detected within 12 h. L-T_3 appeared to be at least 9 times more potent in vivo than T_4, as assessed from the effect on pituitary GH. The measurement by RIA of changes in GH content of the rat pituitary may thus provide the most adequate parameter available at present (other than suppression of TRH-induced TSH release) for a biological effect in vivo of single doses of the thyroid hormones, a measurement clearly related to an important physiological role. (auth)

14674 COMPARISON OF UNENRICHED VERSUS ^{15}N-ENRICHED FERTILIZER AS A TRACER FOR N FERTILIZER UPTAKE. Meints, V. W. (Univ. of Illinois, Urbana); Shearer, G.; Kohl, D. H.; Kurtz, L. T. Soil Sci.; 119: No. 6, 421-425(Jun 1975).

A greenhouse experiment was conducted on three soils with differing cropping and fertilization histories to determine whether unenriched fertilizer N can be used in the same manner as ^{15}N-enriched fertilizer to estimate the amount of plant N derived from fertilizer. Estimates using unenriched fertilizer N were compared with estimates using two ^{15}N enrichment levels. Use of unenriched fertilizer N led to underestimation of the amount of fertilizer N in the plant material in four of six cases when compared to ^{15}N-enriched fertilizer. Standard deviations of the estimates of fertilizer-derived N in plant material were considerably greater when unenriched fertilizer was used. (auth)

14675 INVESTIGATION FOR EXTRACTING MORE INFORMATION FROM COMPUTERIZED TOMOGRAPHY SCANS. Reese, D. F.; O'Brien, P. C.; Beeler, G. W. Jr.; Gerding, P. R.; McCullough, E. C. (Mayo Clinic, Rochester, MN). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 124: No. 2, 177-185(Jun 1975).

From 75th annual meeting of the American Roentgen Ray Society; San Francisco, CA (24 Sep 1974).

Because computerized tomography scans produce their information in digital form, the information is in a natural format for statistical and mathematical analyses and redisplay in various forms. Histograms were chosen as a redisplay format. Further refinements and experience will be necessary before the method is clinically applicable. (auth)

14676 COMPUTERIZED AXIAL TOMOGRAPHY OF THE CEREBRAL VENTRICLES AND SUBARACHNOID SPACES. Cornell, S. H.; Christie, J. H.; Chiu, C. L.; Lyon, L. W. (Univ. of Iowa Hospital, Iowa City). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 124: No. 2, 186-194(Jun 1975).

From 75th annual meeting of the American Roentgen Ray Society; San Francisco, CA (24 Sep 1974).

Pathologic alterations of the cerebral ventricles and subarachnoid spaces are well demonstrated by computerized tomography with the EMI scanner. Hydrocephalus, arachnoid and porencephalic cysts, cerebral atrophy, tumors, hemorrhages, and congenital anomalies are illustrated. These examples were selected from the scans of more than 500 patients. (auth)

14677 INCREASED INTRACRANIAL PRESSURE: EVALUATION BY COMPUTERIZED TOMOGRAPHY. Lightfoote, W. E.; Pressman, B. D. (George Washington Univ. Medical Center, Washington, DC). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 124: No. 2, 195-198(Jun 1975).

Computerized tomography is clearly very useful in the evaluation of patients with increased intracranial pressure and suspected pseudotumor cerebri. It provides an index of ventricular size and configuration and has the capability of demonstrating intracranial lesions. Moreover, this new technique is rapid and non-invasive, and is without attendant risks. Examinations may be performed serially as the clinical process evolves, thereby giving roentgenographic correlation to the clinical features. (auth)

14678 EXPERIMENTAL STUDIES TO DETERMINE APPLICATION OF CAT SCANNING TO THE HUMAN BODY. Alfidi, R. J.; MacIntyre, W. J.; Meaney, T. F.; Chernak, E. S.; Janicki, P.; Tarar, R.; Levin, H. (Cleveland Clinic Foundation, Ohio). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 124: No. 2, 199-207(Jun 1975).

From 75th annual meeting of the American Roentgen Ray Society; San Francisco, CA (24 Sep 1974).

At present, limitations of space and specimen study in the EMI Scanner make it difficult to predict the future utility of total body scanning. Certainly anatomic cross sections are a reality and provide considerable information on the size, location, and configuration of various intraabdominal and intrathoracic organs. With the exception of cystic lesions, intraorgan pathology in solid organs, such as the liver, spleen, and kidneys does not appear to have significant value at this time. A conclusive study utilizing contrast agents and total body scanning will be required to answer this question. The study of pancreas, adrenal, thyroid, bone, and breast tissue appears to have considerable promise. Lastly, it is stressed that a range of densities exists for various organs and that variations outside of the limits stated in this paper will most probably be found when larger numbers of organs are studied. (auth)

14679 COMPUTERIZED TRANSVERSE TOMOGRAPHY OF VASCULAR LESIONS OF THE BRAIN. I. Arteriovenous Malformations. Pressman, B. D.; Kirkwood, J. R.; Davis, D. O. (George Washington Univ. Medical Center, Washington, DC). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 124: No. 2, 208-214(Jun 1975).

Computerized transverse tomography (CTT) of the brain is a recently developed method which allows non-invasive roentgenologic evaluation of intracranial disease. Since its inception, major attention has been given to the diagnosis and evaluation of tumors, clots, infarcts, ventricular size, and orbital lesions. The purpose of this report is to discuss the application of CTT to the diagnosis and evaluation of intracerebral arteriovenous malformations. (auth)

14680 COMPUTERIZED TRANSVERSE TOMOGRAPHY OF VASCULAR LESIONS OF THE BRAIN. II. Aneurysms. Pressman, B. D.; Gilbert, G. E.; Davis, D. O. (George Washington Univ. Medical Center, Washington, DC). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 124: No. 2, 215-219(Jun 1975).

Computerized transverse tomography (CTT) is an excellent screening examination for intracerebral disease. Unfortunately, the detection rate of small aneurysms by this procedure is not high. Nevertheless, CTT may be useful in aneurysm cases since it may indicate the need for further evaluation in patients with associated hematomas, encephalomalacia, or ventricular dilatation, even if the aneurysm itself is not delineated. (auth)

14681 ORBITAL RADIONUCLIDE EXAMINATIONS. Grove, A. S. Jr. (Harvard Medical School, Boston). Trans. Am. Acad. Ophthalmol. Oto-Laryngol.; 78: 587-598(1974).

From 68th annual meeting of the American Academy of Ophthalmology and Oto-laryngology; Dallas, TX (Sep 16-20, 1973).

Orbital abnormalities can be evaluated by dynamic scintigraphy (radionuclide angiography) and static scintigraphy (radionuclide "scanning"). The use of en face positioning improves the visualization of orbital details. Lesions can be detected and localized most accurately if multiple tracers are used for these studies. Abnormalities can be characterized by the recognition of various angiographic flow patterns, of distinct static distribution patterns, and of differences in the accumulation of multiple radiopharmaceuticals. The results of scintigraphic examination using technetium 99m sodium pertechnetate, mercury 197 chlormerodrin, and gallium 67 citrate in a series of 57 patients are reported. (auth)

14682 ANIMAL MODEL OF RADIONUCLIDE VENOGRAPHY. Henkin, R. E.; Martonffy, K.; Kenfield, K.; Yao, J. S. T.; Quinn, J. L. III. (Northwestern Medical School, Chicago). Radiology; 116: No. 1, 211-213(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(1 Dec 1974).

Experimental venous thrombi were created in 19 dogs, using either thrombin or sodium morrhuate. Eighteen thrombi (95 percent) were identified by radionuclide venography; however, an 85 percent false-positive rate was found when nonoperated limbs were studied. The models employed were considered unsuitable for studying the accuracy of labeled particles in diagnosing deep venous thrombosis for the reasons discussed in the text. (auth)

14683 GUIDELINES FOR RADIOACTIVE TRACER STUDIES OF THE HEART AND CIRCULATION. Report of the Inter-Society Commission for Heart Disease Resources. Adelstein, S. J. (Harvard Medical School, Boston). Radiology; 116: No. 1, 229-230(Jul 1975).

The Inter-Society Commission for Heart Disease Resources report concerning optimal resource guidelines for radioactive tracer studies of the heart and circulation is described. This report is an overview of the status of cardiovascular radionuclide diagnostic studies as well as a guideline to the hospital resources (physical and human) required for a high-quality nuclear medicine laboratory dealing with this area of study. These guidelines are directed to physicians and hospital administrators who are currently responsible for planning and organizing nuclear medicine programs or who anticipate a future need for such services in their community. (auth)

14684 NEW METHOD OF DIAGNOSING MYOCARDIAL CONTUSION IN MAN BY RADIONUCLIDE IMAGING. Go, R. T.; Doty, D. B.; Chiu, C. L.; Christie, J. H. (Univ. of Iowa, Iowa City). Radiology; 116: No. 1, 107-110(Jul 1975).

A new method of diagnosing myocardial contusion was studied in eight patients in whom the injured mycardium was visualized as an abnormal area of increased activity in the region of the heart one hour after intravenous injection of 10 mCi of /sup 99m/-Tc-Sn-polyphosphate or pyrophosphate. Serum enzymes in these patients were elevated, but electrocardiograms were nonspecific for myocardial injury. It is hoped that this new technique of imaging the injured myocardium will provide specific and confirmatory diagnosis of myocardial contusion associated with closed chest injuries. (auth)

14685 COMPARISON OF VENTRICULAR ENLARGEMENT AND RADIOPHARMACEUTICAL RETENTION: A CISTERNOGRAPHIC–PNEUMOENCEPHALOGRAPHIC COMPARISON. Bartelt, D.; Jordan, C. E.; Stecker, E. P.; James, A. E. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 116: No. 1, 111-116(Jul 1975).

From 58th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (26 Nov 1972).

The cisternograms and pneumoencephalograms of 58 patients with suspected normal pressure hydrocephalus were correlated and the relationship of ventricular radiopharmaceutical entry and stasis to ventricular size was analyzed. It was found that radiopharmaceutical entry relates directly to ventricular size, stasis occurring only in markedly enlarged ventricles. Cerebrospinal fluid imaging alone is a highly reliable diagnostic study only if patients exhibit the characteristic cisternographic patterns of normal pressure hydrocephalus. In those who do not, pneumoencephalography and cisternography are valuable complementary studies which can also be used to identify primary cortical atrophy. (auth)

14686 EFFICACY OF THE BRAIN SCAN IN DIAGNOSIS OF BRAINSTEM GLIOMAS. Feigin, D. S.; Welch, D. M.; Siegel, B. A.; James, A. E. Jr. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 116: No. 1, 117-120(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (1 Dec 1974).

Nineteen cases of brainstem glioma were reviewed to evaluate lesion detection by brain imaging and other radiological methods. /sup 99m/Tc-pertechnetate brain imaging was definitely abnormal in only one patient. Other techniques proved to be more sensitive and specific. Angiograms were abnormal in 10 of 18 cases while pneumoencephalography demonstrated the lesion in 16 of 19 cases. Brain imaging is not a sensitive diagnostic study in patients with suspected brainstem glioma. A normal brain scan is not useful in excluding this diagnosis and further radiological evaluation is necessary. (auth)

14687 FURTHER EVALUATION OF /sup 99m/Tc SULFUR COLLOID ACCUMULATION IN REJECTING RENAL TRANSPLANTS IN MAN AND A CANINE MODEL. George, E. A.; Codd, J. E.; Newton, W. T.; Henry, R. E.; Donati, R. M. (St. Louis Veterans Administration Hospital). Radiology; 116: No. 1, 121-126(Jul 1975).

Renal transplant accumulation of /sup 99m/Tc sulfur colloid was evaluated in 41 patients. Ninety-five examinations were performed comparing transplant with bone marrow activity and clinical or pathological diagnosis. The /sup 99m/Tc sulfur colloid accumulated in acute or chronic rejection as long as the vascular supply of the grafted kidney was not severely impaired. Accumulation was marked in chronic rejection, slight in acute rejection and absent in normally functioning transplants or in those with acute tubular necrosis. In the 10 dog models, no accumulation was seen in autografted transplants and early accumulation was demonstrated within the hyperacutely rejecting kidneys of allografted dogs. (auth)

14688 RADIOIMMUNOASSAY OF α-FETOPROTEIN. I. Technique and Serum Levels in the Normal Adult. Masseyeff, R.; Bonet, C.; Drouet, J.; Sudaka, P.; Lalanne, C. (Ecole de Medicine, Nice). Digestion; 10: 17-28(1974).

A method of radioimmunoassay of human α-fetoprotein (AFP) is described. It allows the assay of this protein in human serum with a sensitivity threshold of 0.1 ng of AFP per ml of serum. One hundred and ninety two normal adult sera were assayed. The average level was 2.6 ng/ml with a standard deviation of 1.6 ng/ml. (auth)

14689 BLOCKADE BY INTERRUPTION OF CONTACT BETWEEN CELL BODY AND AXON. Frizell, M.; McLean, W. G.; Sjoestrand, J. Brain Res.; 86: No. 1, 67-73(Mar 1975).

The influence of ligation and colchicine treatment on the axonal transport of slowly migrating (^{3}H)leucine-labelled proteins was studied in the vagus nerve of the rabbit. Two days after (^{3}H)leucine labelling of the dorsal motor nucleus of the vagus nerve, ligation or local application of 60 mM colchicine immediately blocked the further progression of slowly migrating proteins distal to the site of treatment. Application of 50 to 100 μg colchicine to the nerve cell bodies 2 days after labelling blocked the transport of slowly migrating proteins within the next 24 h. It is suggested that contact between nerve cell body and the axon is necessary for the maintainance of the slow transport of proteins in these nerves. (NL)

14690 SELECTIVE UPTAKE OF (^{3}H)β-ALANINE BY GLIA. Association With the Glial Uptake System for GABA. Schon, F.; Kelly, J. S. (Medical School, Cambridge, Eng.). Brain Res.; 86: No. 2, 243-257(Mar 1975).

The γ-aminobutyric acid (GABA) analogue, β-alanine is almost as good a substrate as GABA itself in the glial cell uptake system. Tritiated β-alanine accumulates exclusively and with high affinity in glial sites in both sensory ganglia and slices of cerebral cortex. GABA acts as an inhibitor for the β-alanine uptake process. The kinetics of this competitive inhibition on β-alanine uptake in cortical slices suggests that intact glial sites of GABA uptake are present in such slices in addition to the more prominent and well documented uptake system in nerve terminals. The possible importance of such glial fragments in brain slice and crude synaptosomal preparations is discussed. (NL)

14691 ROLE OF THE MALIC ENZYME REACTION IN PLANT ROOTS. Utilization of [2,3-^{14}C]Malate, [4-^{14}C]Malate, and [1-^{14}C]Pyruvate by Pea Root Apices and Measurements of Enzyme Activity. Fowler, M. W. (Univ. of Sheffield, Eng.). Biochim. Biophys. Acta; 372: No. 2, 245-254(5 Dec 1974).

The aim of the work was to ascertain in the apices of pea seedling roots the predominant direction of metabolite flow through the malic enzyme reaction. The approach used was to study the distribution of ^{14}C in cell fractions isolated from root tissues supplied with [4-^{14}C]malate, [2,3-^{14}C]malate, and [1-^{14}C] pyruvate. The data are consistent with the flow of carbon through the malic enzyme reaction in the direction of malate decarboxylation and NADPH formation. On a fresh weight basis the highest carbon flow through the reaction was observed in the apical 3 mm of the root tip. Under these circumstances the malic enzyme is contributing to NADPH production, probably for reductive biosynthesis in the root apex. (NL)

14692 RADIOIMMUNOASSAY OF HUMAN SERUM ANTIBODY SPECIFIC FOR ADENOVIRUS TYPE 5-PURIFIED FIBER. Scott, J. V.; Dreesman, G. R.; Spira, G.; Kasel, J. A. (Baylor College of Medicine, Houston, TX). J. Immunol.; 115: No. 1, 124-128 (Jul 1975).

A radioimmunoassay (RIA), utilizing a second antibody to separate immune complexes, was developed to provide a sensitive and specific measure of serum antibody to adenovirus type 5 (Ad 5) fiber. Purity of fiber antigen was ascertained by sodium dodecyl sulfate urea-polyacrylamide gel electrophoresis and isoelectric focusing in ampholyte pH gradients. After labeling with ^{125}I to high specific activity, the iodinated fiber did not exhibit loss of antigenic reactivity and remained stable for 3 weeks when stored at -20°C with supplemental protein. Rabbit anti-Ad 5 serum with a neutralization titer of 1:320 precipitated 50 percent of the labeled fiber at a serum dilution of 1:50,000 when tested by the RIA. In competition assays as little as 0.5 ng of unlabeled fiber per milliliter was sufficient to inhibit the ^{125}I fiber-antibody reaction. Serum specimens from 20 volunteers, obtained before and after vaccination with purified Ad 5 fiber or hexon subunit vaccine, were tested by RIA, hemagglutination-inhibition (HI), and neutralization tests. A comparison of mean antibody titers of post-inoculation sera showed that the RIA was 300 and 1000 times more sensitive than the HI and neutralization tests, respectively. Moreover, 19 of the men who were negative by the standard serologic tests before vaccination were shown to have anti-fiber antibody, with a mean RIA titer of 1:1028. Specificity of the RIA was demonstrated by the lack of an increase in antibody to Ad 5 fiber among those individuals vaccinated with the hexon subunit. Thus, the development of a highly sensitive and reproducible RIA allows for the detection of antibody specific for the Ad 5 fiber in serum which contains antibodies to the different virion antigenic determinants associated with Ad 5. (auth)

14693 ENZYMATIC SOLID-PHASE METHOD FOR TRACE IODINATION OF PROTEINS AND PEPTIDES WITH ^{125}I. Karonen, S. L.; Morsky, P.; Siren, M.; Seuderling, U. (Univ. of Helsinki). Anal. Biochem.; 67: No. 1, 1-10(Jul 1975).

Solid-phase methodology has previously been applied to labeling of proteins and peptide hormones used in immunoassay with the aid of enzyme sorbent. In this publication a method based on the use of a new carrier-copolymer of maleic anhydride and butanediol divinylether is introduced. As a model, bovine serum albumin (BSA) was labeled using three different procedures: chemical, with chloramine-T as oxidizing agent; enzymatic, in a liquid phase with lactoperoxidase (LP) and horseradish peroxidase (HRP); and enzymatic, in a solid phase with maleic anhydride butanediol divinylether-copolymer as the carrier of lactoperoxidase and horseradish peroxidase. The lactoperoxidase-mediated iodinating activity in both the liquid and solid phases was similar (incorporating 47 and 39 percent for the total ^{125}I added, 1 mCi/10 mu g BSA), while HRP was more efficient in a liquid (11 percent) than in a solid phase (3 percent). Although the specific activity of the BSA labeled with chloramine-T was highest, this ^{125}I-labeled BSA was badly degraded during iodination. However, in either liquid or solid phase enzymatic iodinations, no degradation of the protein could be observed. Peptide hormones, luteinizing hormone, follicle-stimulating hormone, and angiotensin II, iodinated with lactoperoxidase or lactoperoxidase sorbent for radioimmunoassays reacted better than peptide hormones iodinated with chemical oxidants and remained unaltered during storage. (auth)

14694 HIGHLY EFFICIENT SOLID-PHASE RADIOIMMUNE ASSAY FOR A CLOSTRIDIAL TOXIN. Lieberman, M. (Cutter Labs., Inc., Berkeley, CA). Anal. Biochem.; 67: No. 1, 115-121(Jul 1975).

A solid-phase radioimmune assay was developed for the epsilon toxin from Clostridium perfringens type D. The assay is highly efficient, allowing for use in quantitating the antigen in crude as well as purified preparations of material. (auth)

14695 UNDERESTIMATION OF CYCLIC 3',5'-NUCLEOTIDE PHOSPHODIESTERASE ACTIVITY BY A RADIOISOTOPIC ASSAY USING AN ANIONIC-EXCHANGE RESIN. Lynch, T. J.; Cheung, W. Y. (St. Jude Children's Research Hospital, Memphis). Anal. Biochem.; 67: No. 1, 130-138(Jul 1975).

The anionic-exchange resin technique utilizing isotopically labeled cyclic AMP (or cyclic GMP) and an auxiliary enzyme, 5'-nucleotidase, for the assay of phosphodiesterase (Thompson, M. J., and Appleman, M. M. (1971) Biochemistry 10, 311) does not accurately measure the enzyme activity due to adsorption of the product (adenosine or guanosine) by the resin. Binding of adenosine or guanosine by the resin may lead to an underestimation of phosphodiesterase activity. Under comparable conditions, adsorption of guanosine by the resin is much larger than that of adenosine. Consequently, cyclic GMP phosphodiesterase activity is underestimated more than cyclic AMP phosphodiesterase activity. (auth)

14696 DETERMINATION OF PLATELET SEROTONIN BY RADIOIMMUNOASSAY AND COMPARISON WITH THE SPECTROPHOTOFLUOROMETRIC METHOD. O'Brien, R. A.; Spector, S. (Roche Inst. of Molecular Biology, Nutley, NJ). Anal. Biochem.; 67: No. 1, 336-338(Jul 1975).

The 5-hydroxytryptamine (5-HT) radioimmunoassay (RIA) has been adapted to estimate blood platelet 5-HT. Comparison with the spectrophotofluorometric method indicates that the RIA is not only adequate but has the advantage of being considerably easier and requiring less tissue. (auth)

14697 HETEROLOGOUS RADIOIMMUNOASSAY FOR PLASMA HUMAN PROLACTIN (hPRL): VALUES IN NORMAL SUBJECTS, PUBERTY, PREGNANCY, AND IN PITUITARY DISORDERS. Aubert, M. L.; Grumbach, M. M.; Kaplan, S. L. (Univ. of California, San Francisco). Acta Endocrinol.; 77: No. 3, 460-476(Nov 1974).

A heterologous radioimmunoassay for human prolactin (hPRL) was developed, using a rabbit anti-ovine PRL (oPRL) which cross-reacted with hPRL and hPRL (Lewis 203-1) as tracer and standard. The sensitivity (0.02 ng hPRL) and the values obtained were comparable to those in homologous assays. Antibodies to hPRL were detected in 2 anti-hGH sera. The mean concentration of plasma hPRL in adult females (8.5 ± 1.5 ng/ml ± SE) was significantly higher than in males (5.2 ± 0.5; P = 0.025). Plasma values of hPRL in girls between 4 and 17 years of age (7.2 ± 0.5) were not significantly different than in boys of the same age (6.0 ± 0.5). (auth)

14698 RADIOIMMUNOASSAY OF PROSTAGLANDINS Fα AND E_1 IN HUMAN PLASMA. Dray, F.; Charbonnel, B. (Institut Pasteur, 75- Paris (France)). pp 133-158 of Seminaire INSERM. Boulogne, France; Institut National de la Sante et de la Recherche Medicale ([nd]). (In French)

From Seminar on prostaglandins; Royaumont, France (4 Oct 1973).

Antibodies against prostaglandins (PG) $F_2\alpha$ and E_1 are obtained in rabbits immunized with respectively PG $F_2\alpha$ and PG E_1 conjugated to bovine serum albumin by carbodiimide. A radioimmunoassay capable of measuring 7 pg of PG Fα and 10 pg of PG E_1 in human peripheral plasma is described. Plasma samples (pH 3, citric acid) are extracted with cyclohexane/ethylacetate, 1/1 and then chromatographed on silicic acid columns to separate the prostaglandins into three major groups, (1 PG A, PG B, and some unknown immunoreactive compounds, (2) PG E, (3) PG Fα. The recovery of 500 cpm ^3H PG $F_1\alpha$ and 500 cpm ^3H PG E_1 is about 80%. The mean plasma PG Fα and PG E_1 levels are found much lower than those published: for PG Fα in 18 adult males: 9.3 + -3.5 pg/ml; in 11 adult females, follicular phase: 6.4 + -2.7 pg/ml; in 12 adult females, luteal phase: 5.7 + -2.3 pg/ml. For PG E_1 in 14 both sex adults: 4.2 + -4.8 pg/ml. A comparison between serum and plasma PGα from 11 blood samples indicates a higher value ($p < 0.01$) in serum, 31.5 + -15 pg/ml than in plasma 8.2 + -1.5 pg/ml. (FR)

14699 RELIABILITY OF RADIOACTIVE INULIN AS A MARKER OF GLOMERULAR FILTRATION RATE IN THE RAT. Andreucci, V. E.; Dal Canton, A.; Corradi, A. (Parma Univ. (Italy). 2. Clinica Medica). Pfluegers Arch. - Eur. J. Physiol.; 350: No. 4, 347-358(1974).

1 fig.; 4 tabs.; 19 refs.

Clearance experiments were carried out in rats for evaluating the reliability of Inulin-Methoxy-^3H as marker for glomerular filtration rate (GFR) determination. When ^3H-inulin clearance was compared with ^{14}C-Polyethylen Glycol (PEG) 1,000 clearance, a linear relationship was observed (y = 0.021 + 0.867x; r = 0.98). ^3H-inulin clearance ^{14}C-PEG clearance ratio was 0.88 + -0.09 (S. D.), i.e. a value no different from those reported in literature for unlabelled inulin, ^{14}C Inulin, and Polyfructosan S. Several types of scintillation solution were tested to evaluate the stability with time of count rate of radioactive inulin. A perfect reproducibility with time was observed in the clearance values in the kidney as a whole (GFR) and in single nephrons (SNGFR) with the following scintillators: Triton X 100-Toluene-PPO, Aquasol, and Instagel. Useful suggestions on the way of using labelled inulin are given. (auth)

14700 STUDIES ON CHOLINE PERMEATION THROUGH THE PLASMA MEMBRANE AND ITS INCORPORATION INTO PHOSPHATIDYL CHOLINE OF EHRLICH-LETTRE-ASCITES TUMOR CELLS IN VITRO. Haeffner, E. W. (Deutsches Krebsforschungszentrum, Heidelberg (F. R. Germany). Inst. fuer Zellforschung). Eur. J. Biochem.; 51: No. 1, 219-228(Feb 1975).

8 figs.; 4 tabs.; 32 refs.

The initial rate of incorporation of ^{14}C- or ^3H-labeled choline into Ehrlich-Lettre ascites cells of the glycogen-free strain seven days after inoculation was investigated in vitro. At medium

choline concentrations the uptake followed Michaelis–Menton kinetics. The K_m-values increased with increasing temperature. The energy of activation for choline uptake was determined to be 16 kcal/mol. It is assumed that two systems exist for the choline uptake by the ascites cells. One, operative at low substrate concentrations, which is saturable and probably is to be classified as a carrier-mediated facilitated diffusion process. It can be inhibited by deoxyglucose or 2,4-DNP and also by substrate analogues. The other system functioning at high choline concentrations may be a simple diffusion process, which is also inhibited by 2,4-DNP and p-chloromercuribenzoate. Choline incorporation into lecithin gave linear Michaelis–Menton kinetics at the low and the high substrate concentration respectively. K_m-values decreased with an increase in temperature at low and increased at high substrate concentrations thus reflecting a close relationship between choline uptake and its metabolism. Treatment of the cells with p-chloromercuribenzoate or heat shock at 50°C markedly reduced the choline uptake and concomitantly its conversion into lecithin. The inhibitory effect of p-chloromercuribenzoate was competitive and that of the heat shock non-competitive in nature. Further the choline uptake by the cells was found to be the rate-limiting step. Pulse chase experiments showed a rapid turnover of the choline moiety with a concomitant increase in activity of the lecithin fraction and little change within the choline phosphate pool. (auth)

14701 EXAMINATION OF SOME FACTORS AFFECTING SENSITIVITY AND REPRODUCIBILITY IN RADIOIMMUNOASSAY OF THYROTROPIN. Moser, R. J.; Hollingsworth, D. R. (Univ. of Kentucky, Lexington). Clin. Chem.; 21: No. 3, 347-352(Mar 1975).

Conditions for measuring human thyrotropin by radioimmunoassay have been investigated, to improve the sensitivity and reproducibility of the assay. The Chloramine-T method of iodination was used, the reaction time being 20 s. Doubling the iodination reaction volume from 55 to 95 mu l did not affect the immunoreactivity. Purification of labeled hormone by use of anion-exchange resin followed by silica (Quso G-32) instead of Sephadex gelfiltration or anion exchange alone yielded a product that was the least (less than 4 percent) contaminated with Na ^{125}I. Human serum albumin (2.5 g/liter) in phosphate-buffered saline, instead of bovine serum, should be used as diluent for unknowns; within-assay variance was 3 percent for the former, 62 percent for the latter. The assay worked equally well for both pregnant and nonpregnant patients, with use of 50 to 100 mu l of serum per determination. A five-week-old labeled hormone yielded higher values than did two-week-old material. In 29 euthyroid patients the mean thyrotropin value was 5.7 microunits/ml (range 2.8 to 11); nine hypothyroid patients had a mean of 112 microunits/ml (range 38 to 267); and 13 hyperthyroid subjects showed suppressed thyrotropin with a mean of 3.1 microunits/ml (range 2.2 to 4.5). Following these suggestions, one can expect a highly purified immunoreactive tracer and a sensitive assay. (auth)

14702 ROUTINE RADIOIMMUNOASSAY OF PLASMA TESTOSTERONE AND RESULTS FOR VARIOUS ENDOCRINE DISORDERS. Wong, P. Y.; Wood, D. E.; Johnson, T. (Toronto General Hospital). Clin. Chem.; 21: No. 2, 206-210(Feb 1975).

A modification of published methods for radioimmunoassay of plasma testosterone is described. This simpler method involves no chromatographic steps, and the necessary reagents, including tritiated testosterone and testosterone anti-serum, are commercially available. A digital computer is used for the calculation. Without difficulty, a technician can complete 100 assays in three working days. Mean testosterone concentrations (+-2 SD) in the plasmas of 21 normal mean and 26 women with a normal menstrual cycle were 684 +- 300 and 45 +- 20 ng/dl, respectively. Within- and between-assay precision (coefficient of variation) were 5.2 percent (n equals 29) and 6.7 percent (n equals 26), respectively. More than 1000 samples were assayed during the past year. Data are given on the concentrations of testosterone in plasma of patients with various endocrine disorders. (auth)

14703 ONE-HOUR RADIOIMMUNOASSAY OF SERUM DRUG CONCENTRATIONS AS EXEMPLIFIED BY DIGOXIN AND GENTAMICIN. Berk, L. S.; Lewis, J. L.; Nelson, J. C. (Loma Linda Univ. Medical Center, CA). Clin. Chem.; 20: No. 9, 1159-1164 (Sep 1974).

Double-antibody radioimmunoassays in which tritium is used for labeling were adapted for emergency determinations of serum drug concentrations. In the cases of digoxin and gentamicin, the first and second antibody incubations may be carried on simultaneously, minimizing incubation times (10 and 27 min, respectively). Counting the bound radioactivity in solubilized immunospecific precipitates decreases variability in the composition of the phase counted and markedly decreases problems of quenching and chemiluminescence. Logit-log transformation of the sigmoidal standard curve results in a straight line, which can be described by its slope and intercept and which remains constant if assay conditions and critical reagents are held constant. Because the slope and intercept of the standard curve are characteristic of a given assay system, it is possible to calculate the theoretical standard curve for a specific assay system by using the means of previously observed slopes and intercepts. Thus, a separate standard curve need not be prepared for each subsequent assay run. Total time required for drug determinations is now less than 1 h. When unknown samples were measured by both the conventional radioimmunoassay method and the new rapid radioimmunoassay method, the values correlated well (r equals 0.99) for both digoxin and gentamicin. (auth)

14704 ELIMINATION OF ERROR CAUSED BY HEMOLYSIS AND BILIRUBIN-INDUCED COLOR QUENCHING IN CLINICAL RADIOIMMUNOASSAYS. Helman, E. Z.; Spiehler, V.; Holland, S. (Beckman Instruments, Inc., Irvine, CA). Clin. Chem.; 20: No. 9, 1187-1193(Sep 1974).

In radioimmunoassays and radioassays for various constituents of serum, color quenching is a source of error when liquid-scintillation methods are used in samples that contain hemolyzed blood and samples from jaundiced patients. A quench correction can be made by using the External Standard Channels Ratio method and normalizing the ratios, or, alternatively, by chemical decolorization with tetramethylammonium hydroxide, hydrogen peroxide, and ascorbic acid. (auth)

14705 RADIOIMMUNOASSAY FOR SERUM TRIIODOTHYRONINE: EVALUATION OF SIMPLE TECHNIQUES TO CONTROL INTERFERENCE FROM BINDING PROTEINS. Fang, V. S.; Refetoff, S. (Univ. of Chicago). Clin. Chem.; 20: No. 9, 1150-1154(Sep 1974).

Simple techniques for controlling interference from binding proteins in serum, such as thyroxine-binding globulin, in radioimmunoassay for triiodothyronine (T_3) were evaluated for their efficacy, and their effect on assay sensitivity and on recovery of added T_3. Heat-inactivation of thyroxine-binding globulin or use of 8-anilino-1-naphthalene sulfonic acid (ANS) to displace T_3 from thyroxine-binding globulin produced comparable recovery rates. The heat-inactivation method slightly decreased the sensitivity of the assay and prolonged the procedure, whereas use of ANS is simple, and the assay sensitivity is maintained. When sera contain a high concentration of thyroxine-binding globulin, a fixed concentration of ANS (175 mu g/100 mu l of serum) might be too low to displace T_3 from all its binding sites, but a concentration of ANS greater than 200 mu g/100 mu l of serum interferes with T_3 quantitation by competitively binding to the antibodies. The cross-reactivity of thyroxine to T_3-antibodies varies with the antiserum. Thyroxine-binding globulin appears to be the only protein in serum that competes with the antibody for T_3 binding. (auth)

14706 METHODOLOGICAL CAUSES OF DISCREPANCIES IN RADIOIMMUNOASSAY FOR DIGOXIN IN HUMAN SERUM. Holtzman, J. L.; Shafer, R. B.; Erickson, R. R. (Veterans Administration Hospital, Minneapolis). Clin. Chem.; 20: No. 9, 1194-1198(Sep 1974).

In a series of 73 patients, definite indications of toxicity were always associated with a serum digoxin concentration of 2.0 ng/ml or higher, while in the possibly intoxicated and nonintoxicated patients only 24 percent and 10 percent, respectively, had a concentration this high. The nonintoxicated patients included significantly more with subnormal serum albumin concentrations. In vitro addition of radiolabeled digoxin and antibody showed that sera from many patients with hypoalbuminemia will enhance the binding of the label, which could result in a digoxin radioimmunoassay value as much as threefold low. These results were unrelated to other serum constituents, including the associated hyperglobulinemia, or to methodologic problems in the immunoassay. The proportion of digoxin bound to serum proteins was not significantly different between the normal (38 percent +- 3 percent) and hypoalbuminemic (31 percent +- 3 percent) individuals, and so this could not explain the difference in the assay results. It was concluded that patients whose serum albumin concentrations are low may show erroneously low radioimmunoassay values for serum digoxin, and that this may explain why some patients receiving high doses of digoxin are found to have unexpectedly low apparent concentrations of digoxin in their serum. (auth)

14707 RADIO SCANNING STUDIES OF EAR AND SINUSES. Kirchner, F. R. (Univ. of Kansas School of Medicine, Kansas City). Laryngoscope; 84: No. 11, 1894-1904(Nov 1974).

From meeting of the middle section of the American Laryngological, Rhinological and Otological Society, Inc.; Kansas City, KS (18 Jan 1974).

Radiophotoscanners are relatively new diagnostic tools. They provide visual images as well as quantitative information about the behavior in the human body of special substances called radionuclides. A preliminary report is presented about the use of a radioactive gas, xenon-133, to study the ventilation of the middle ear and sinuses. At this point these results cannot be considered definitive or conclusive. If standardization and control of variables is achieved, this technique may play an important role in the physiological and pathological assessment of these cavities. (auth)

14708 EXTERNAL MEASUREMENT AND MAPPING OF MYOCARDIAL ISOTOPE AFTER CORONARY VENOUS ^{85}Kr AND ^{133}Xe INJECTIONS. Cibulski, A. A.; Markov, A.; Lehan, P. H.; Galyean, J. R. III; Flowers, W. M. Jr.; Smith, R. O.; Hellems, H. K. (Univ. of Mississippi, Jackson). Am. J. Cardiol.; 34: No. 5, 545-551(3 Oct 1974).

A retrograde coronary venous injection technique for concentrating diffusible radioisotope in ischemic myocardial regions was evaluated. Krypton-85 in saline solution was injected under pressure into the coronary veins during partial closure of the coronary sinus. In the presence of coronary inflow obstruction, the venous ^{85}Kr was distributed mainly to the vessels with reduced pressure in ischemic regions. Krypton-85 washout was monitored with a single precordial collimator, and reasonably accurate measurements of flow in the ischemic regions were made. In two dogs, photoscanning techniques, using ^{133}xenon, were applied to locate and determine the size of the ischemic myocardial regions as radioisotopic hot spots. (auth)

14709 DEVELOPMENT OF A SPECIFIC OVINE THYROTROPIN (TSH) RADIOIMMUNOASSAY FROM NON-SPECIFIC ANTISERA. Borger, M. L.; Davis, S. L. (Pennsylvania State Univ., Hershey). J. Anim. Sci.; 39: No. 4, 768-774(Oct 1974).

The development of a specific ovine thyrotropin (oTSH) radioimmunoassay from non-specific antisera is described. Initial antisera produced in rabbits against NIH-TSH-S6 was found to cross react with ovine luteinizing hormone (oLH) and ovine follicle stimulating hormone (oFSH). Three methods were used to increase the specificity of the oTSH radioimmunoassay: (1) immunoadsorption of the antisera on Sepharose; (2) preadsorption of the antisera with oLH and oFSH; and (3) radioiodination of the beta-subunit of bovine TSH. All three methods resulted in improved specificity of the assay systems for oTSH. As a measure of accuracy of each system, recovery curves were determined with each system. Recovery lines for the three systems had correlation coefficients of 0.999, 0.997, 0.978, intercepts of 0.19, -.70, 0.29 and slopes of 0.93, 1.28, 0.74, respectively, ^{125}I-beta-TSH systems. Plasma levels of oTSH in castrate (6.8 ng/ml) and lactating (6.7 ng/ml) ewes were significantly greater (P less than .01) than for cyclic (4.3 ng/ml) or pregnant (4.0 ng/ml) ewes using this assay system. Plasma levels of oTSH in lambs were significantly (P less than .01) elevated following thyroidectomy (117 vs. 0.8 ng/ml). These data demonstrate the utility of these methods of improving assay specificity when antisera have been demonstrated to be non-specific. (auth)

14710 MEASUREMENT OF BOVINE PLASMA TESTOSTERONE BY RADIOIMMUNOASSAY (RIA) AND BY A RAPID COMPETITIVE PROTEIN BINDING (CPB) ASSAY. Shemesh, M.; Hansel, W. (Cornell Univ., Ithaca, NY). J. Anim. Sci.; 39: No. 4, 720-724(Oct 1974).

Changes in the peripheral plasma level of testosterone during the bovine estrous cycle were determined by a rapid competitive protein-binding assay and by radioimmunoassay, using a specific antiserum against testosterone following chromatographic purification of the steroid on Sephadex LH-20 columns. Values obtained by the two methods were similar. Testosterone concentrations increased during the 3 days preceding estrus and attained peak values (47 +- 9 pg/ml) 10 to 16 hr before the onset of estrus. Minor rises were observed on days 3 to 5 and 11 to 14. The levels of testosterone observed during the cycle generally paralleled the plasma levels of estrogen observed in previous studies. (auth)

14711 RADIOIMMUNOASSAY OF PORCINE FSH. Rayford, P. L.; Brinkley, H. J.; Young, E. P.; Reichert, L. E. Jr. (Univ. of Maryland, College Park). J. Anim. Sci.; 39: No. 2, 348-354 (Aug 1974).

A radioimmunoassay for porcine FSH was developed and validated. The iodinated antigen contained a contaminant that cross reacted with porcine serum. This contaminant was removed by rechromatography of the labeled antigen on a column containing a dowex resin that was equilibrated with porcine serum. Porcine PRL, ACTH, and GH did not compete in the assay. On a mass basis, 125 to 150 times more porcine LH was required for equivalent displacement of ^{131}I PFSH from the antibody. The biologic-radioimmunologic ratios of several crude pituitary extracts ranged from .45 to 1.33. The minimal sensitivity of the RIA was 2.5 ng PFSH LER 1132 (66-67) and the FSH in 500 mu l or less of porcine serum or plasma could be measured accurately and precisely. The RIA was employed to determine the concentration of FSH in the serum of female swine during different experimental states. (auth)

14712 RADIONUCLIDE ANGIOGRAPHY IN JUVENILE ANGIOFIBROMA OF THE NASOPHARYNX. Castor, W. R.; Lentile, B. C.; Glazebrook, G. A. (Cross Cancer Inst., Edmonton, Alberta). Ann. Otol., Rhinol., Laryngol.; 84: No. 1, 107-111(1975).

Radionuclide angiography was performed by intravenous injection of /sup 99 m/Tc-pertechnetate and recorded by serial gamma camera scintiphotographs. Its usefulness as a prebiopsy or preoperative procedure is demonstrated by two case reports of angiofibroma of the nasopharynx and it was also found to be useful for radiation therapy follow-up assessment. Radionuclide angiography offers a convenient and safe method to assess the vascularity of a mass and by this technique the surgeon may be alerted to the possibility of severe postbiopsy hemorrhage and also the occasional dramatic complications of radiological carotid angiography can be avoided. (auth)

14713 FORAGE INTAKE RATES OF MULE DEER ESTIMATED WITH FALLOUT CESIUM-137. Alldredge, A. W.; Lipscomb, J. F.; Whicker, F. W. J. Wildl. Manage.; 38: No. 3, 508-516(Jul 1974).

Forage intake rates of 87 wild, Rocky Mountain mule deer (Odocoileus hemionus) collected over a 2-year period from the Cache la Poudre Drainage, Colorado, were estimated utilizing available data on fallout cesium-137 concentrations in the deer and their inferred diet. The method employed involved the convolution of an intake function and a retention function. Ingestion rates are reported and analyzed by sex, season, and age class. An overall mean forage intake of 21.9 grams air dry forage/kg carcass weight/day was calculated. Adult animals consumed significantly (P less than 0.10) more vegetation per unit weight in summer than in winter and subadults significantly (P less than 0.01) more than adults throughout the year. (auth)

14714 RADIOACTIVE PHOSPHORUS (^{32}P) IN THE DIAGNOSIS OF MALIGNANT SKIN MELANOMA. Putnik, M.; Bekerus, M.; Markovic, L.; Milicevic, K. (Univ., Belgrade). Srp. Arh. Celok. Lek.; 102: No. 2, 137-141(Feb 1974). (In Serbo-Croatian).

The test with radioactive phosphorus (^{32}P) was applied in 117 patients with pigmented tumors of the skin; most of the patients had suspicious malignant melanoma. All patients were operated on; histological examination was performed. In 37 cases of malignant melanoma, the test with ^{32}P was negative in one case only (2.7% false negative). In 80 cases of different pigmented tumors of the skin, histologically proved, the positive test (^{32}P) was found in 11 cases (13.7% false positive). This result proves that the test with radioactive phosphorus is a fairly reliable test in the diagnosis of malignant melanoma. (auth)

14715 RADIOISOTOPE DIAGNOSIS OF PULMONARY EMBOLI. Rajniakova, L.; Hupka, S.; Hrivnakova, A. Bratisl. Lek. Listy; 62: No. 1, 65-73(1974). (In Slovak).

The contribution of perfusion scanning using ^{99m}Tc-Fe-Ma to improvement of diagnosing pulmonary emboli was followed on a clinical group of patients. Perfusion gammagraphy has proved to be a successful easily performable, and in many instances the screening diagnostic method, of pulmonary emboli. Scans of the lungs, particularly the lateral views, often reveal the actual extent of perfusion disorders as well as microembolization in the parenchyma of the lungs that could not be detected roentgenographically. The improvement of perfusion under anticoagulation therapy can further be followed up by lung scans. The findings of perfusion gammagraphy, however, have to be correlated with the anamnesis, the clinical condition, the roentgenographic findings, the electrocardiogram and, particularly in cases with chronic obstructive lung diseases, also with arteriograms. (auth)

14716 SCINTIGRAPHY AT CENTRAL HOSPITALS. Experience and Costs. Kempi, W.; Skarfors, E. Laekartidningen.; 71: No. 39, 3667-3671(25 Sep 1975). (In Swedish).

On the basis of two years' experience of scintigraphic routine procedures at Östersund Hospital the extent to which this discipline can contribute to improvements in diagnostics is discussed. The most frequently occurring investigations at the Isotope Laboratory are reported. In addition estimated cost is presented together with an assessment of the advantages to the patients of the isotope experiments. (auth)

14717 MODIFIED RADIOCHEMICAL ASSAY FOR SERUM FREE FATTY ACID DETERMINATION. Chlouverakis, C.; Hojnicki, D. (State Univ. of New York, Buffalo). Clin. Chim. Acta; 54: 91-98(15 Jul 1974).

Despite the biological importance of the free fatty acid fraction (FFA), simple and accurate methods for its determination are still scanty. Recently a sensitive radiochemical assay was published employing ^{60}Co or ^{63}Ni as a tracer. In this assay, after extraction and purification, the FFA fraction is complexed to the radioactive tracer. The complexes (soaps), being insoluble in aqueous media, are wholly distributed in the organic phase and thus easily separated from the free radioactive tracer. Such radiochemical assays are advantageous since counting of radioactivity is easier to perform, less time consuming and more accurate than titration or colorimetry. Experience with these radioassays are reported and a method using ^{14}C-palmitate and chloroform-methanol extraction is described. (auth)

14718 WHAT CAN MAN EXPECT FROM RADIOISOTOPES? Kniseley, R. M. Rev. IRE; 1: No. 5, 20-27(Mar 1975). (In French).

A brief review is given of the present applications and future possibilities of the use of radioisotopes in medicine and biology. Among the topics discussed are use in clinical diagnostics, in vitro and in vivo tests, methods of visualization, dynamic studies, studies of compartments and spaces, and use of intense radiation sources in biomedical practice. (JSR)

14719 RAPID RADIOIMMUNOASSAY METHOD FOR THE DETECTION OF HEPATITIS B ANTIGEN. Kouroupis, G. M.; Leers, W. D. (Univ. of Toronto). Arch. Gesamte Virusforsch.; 44: 370-376(1974).

An increase in incubation temperature under humid conditions, and a decrease in an incubation time was used to shorten the radioimmunoassay (RIA) method for hepatitis B antigen (HB-Ag) assay. Incubation of the serum to be tested at 47°C for 120 minutes for primary adsorption was as sensitive as the regular test at room temperature (RT°) for 16 hours. In addition, the washing procedure for the removal of labelled antibody was shortened. In order to break hepatitis B antigen-antibody (HB-Ag-Ab) complexes before testing the HB-Ag, sera were heated at 56°C for 30 minutes and then retested by RIA. The heating of the sera resulted in a 2 per cent higher yield of HB-Ag positives. It is recommended that sera be heated before testing for HB-Ag. (auth)

14720 USE OF RADIOACTIVE ISOTOPES TO ASSESS SPLENIC FUNCTION. Woodward, B. (Hammersmith Hospital, London). Med. Lab. Technol.; 30: 259-263(1973).

Radioactive isotope (^{59}Fe, ^{51}Cr, ^{125}I-albumin, and ^{11}Co gas) studies were used to assess splenic function in a patient suffering from myelosclerosis. Blood volume measurements and splenic red cell measurements were made. The capacity of the spleen to both destroy and produce red cells was studied. (auth)

14721 CALCIUM-47 ABSORPTION IN UROLITHIASIS. Blacklock, N. J.; Macleod, M. A. (Royal Naval Hospital, Gosport, Eng.). Brit. J. Urol.; 46: No. 4, 377-384(Aug 1974).

The intestinal calcium absorption was measured in a group of patients with Ca-containing kidney stones using an external ^{47}Ca counting technique. Hyperabsorption of Ca was found in 82% and was even more prevalent in the recurrent cases. Comparison of absorption with urinary calcium excretion showed greater correlation in a group of recurrent stone formers than in cases of apparently solitary stone formation. The finding of intestinal hyperabsorption of calcium in a high proportion of stone formers may be etiologically significant in the parenchymal calcium deposition found in these cases. (auth)

14722 INTEREST OF SALIVARY GLAND SCINTIGRAPHY. Hausler, R. J.; N'Guyen, V. T. (Univ., Geneva). Praxis (Bern); 63: No. 32, 969-974(13 Aug 1974). (In French).

The results obtained in the scintigraphic examination of 28 patients with diseases of the salivary glands were reported and compared with results obtained with normal subjects and with the results of clinical and surgical examinations of the patients. The method is based on the intravenous injection of ^{99m}Tc followed by a measurement of the radioactivity in the parotid, submaxillary, and buccal cavity regions and in the blood circulation for one hour. The indicators used in the evaluation of the scintigrams are defined and the limitations of the method are discussed. (JSR)

14723 RADIOIMMUNOASSAY OF HUMAN PLACENTAL LACTOGEN SYNTHESIZED ON RIBOSOMES ISOLATED FROM FIRST TRIMESTER AND THIRD TRIMESTER PLACENTAE. Boime, I.; Boguslawski, S. (Washington Univ. Medical School, St. Louis). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 45: No. 1, 104-106(Sep 1974).

The levels of human placental lactogen synthesized by ribosomes isolated from human placentae at different periods of gestation are reported using a convenient and reliable commercial radioimmunoassay system. The data are consistent with the hypothesis that the amount of this human hormone synthesized reflects the in vivo differentiation of the placenta during pregnancy. Iodine-125-labelled lactogen was used in the system. (ERB)

14724 PREFERENTIAL IN VIVO LOCALIZATION OF ^{125}I-LABELED ANTIBODY IN A CARCINOGEN-INDUCED SYNGENEIC RAT TUMOR. Bale, W. F.; Contreras, M. A.; Izzo, M. J.; Della Penta, D. (Univ. of Rochester, NY). Prog. Exp. Tumor Res.; 19: 270-283(1974).

Results are reported of studies on the preferential localization of a tumor using ^{125}I-labeled antibody in which the tumor investigated was a fibrosarcoma, induced by methylcholanthrene in a Fischer-344 (F-344) strain rat, and carried by transplantation in F-344 rats. The source of antibody was antiserum obtained from Buffalo strain rats following repeated inoculation with this tumor. (CH)

14725 DISTRIBUTION OF ^{14}C LABELED CYCLOCILLIN IN LIVING TISSUE WITH AUTORADIOGRAPHY OF THE ENTIRE BODY. II. State of ^{14}C-cyclacillin in the Experimental Inflammatory Lesions in the Bottom of the Mouth. Hasegawa, A.; Tsuchida, T.; Okagi, H.; Nishimura, K. (Nippon Dental Coll., Tokyo). Nippon Kokua Gakkai Zasshi; 23: No. 3, 509-513(Jul 1974). (In Japanese).

The distribution of ^{14}C-cyclacillin in experimental inflammatory lesions in the bottom of the mouth of mice was studied with frozen tissue autoradiography, and the results showed that ^{14}C-cyclacillin became incorporated into the lesions during 6 hours after the bacterial infection. Radioactivity was higher in the bottom of the mouth around the infective lesion, and high radioactivity was seen in the lower jaw by the autoradiogram of the forehead section 6 hours after the bacterial infection. (JA)

14726 EARLY HISTORY (1936-1946) OF NUCLEAR MEDICINE IN THYROID STUDIES AT MASSACHUSETTS GENERAL HOSPITAL. Evans, R.D. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Med. Phys. 2: No. 3, 105-109 (May 1975).

A recounting of the beginnings of nuclear medicine is given with a review of thyroid studies at Massachusetts General Hospital using radioactive iodine. (AIP)

14727 RADIOIMMUNOASSAY OF POLYPEPTIDE HORMONES AND ENZYMES. Felber, J. P. (Univ., Lausanne, Switzerland). Methods Biochem. Anal.; 22: 1-94(1974).

General principles of radioimmunoassay are reviewed. Detailed procedures are reviewed for the following hormones: insulin, pituitary hormones, gonadotropins, parathyroid hormone, ACTH, glucagon, gastrin, and peptide hormones. Radioimmunoassay of enzymes is also discussed. (HLW)

14728 CRITICAL EVALUATION OF HEPATIC SCINTIANGIOGRAPHY FOR NEOPLASTIC TUMORS OF THE LIVER. Stadalnik, R. C.; DeNardo, S. J.; DeNardo, G. L.; Raventos, A. (Univ. of California, Davis). J. Nucl. Med.; 16: No. 7, 595-601(Jul 1975).

Dynamic hepatic scintiangiography increases the specificity of diagnosis of space-occupying lesions of the liver seen on hepatic scintigraphy. The purpose of this study was to evaluate and compare critically this procedure with histologic and radiopaque diagnosis in the evaluation of suspected hepatic neoplasms. Ninety-two patients had hepatic scintiangiography, scintigraphy, and histologic verification. In ten of these patients, the findings of radiopaque arteriography were compared with those of hepatic scintiangiography. In all ten patients with hepatoma, the scintiangiographic and histologic observations correlated; nine of these ten patients had a tumor stain. Fifty-one of 59 patients with metastases to the liver had scintiangiograms that showed tumor stain. In two of these 59 patients, scintiangiography revealed tumor vascularity whereas the results of scintigraphy were normal. In two of four patients with metastases and two of six patients with hepatomas, scintiangiograms revealed tumor stain that was not evident on radiopaque arteriography. Conclusions from this study are: neoplastic arterialization or tumor stain is more readily detected by scintiangiography than by radiopaque arteriography; a normal scintigram and a tumor stain on the scintiangiogram in a patient with a known primary neoplasm outside the liver is suggestive of hepatic metastases; and a normal scintigram and scintiangiogram make neoplastic involvement of the liver improbable. Dynamic hepatic scintiangiography is a simple, clinically useful method for increasing the specificity of diagnosis of space-occupying lesions of the liver and should be part of the evaluation for possible neoplastic involvement. (auth)

14729 RENAL IMAGING IN /sup 99m/Tc-POLYPHOSPHATE BONE SCANNING: FOCAL INCREASED RENAL UPTAKE IN METASTATIC CARCINOMA OF LUNG. Fitzer, P. M. (Riverside Hospital, Newport News, VA). J. Nucl. Med.; 16: No. 7, 602-604(Jul 1975).

A small group of patients with normal intravenous urograms showed focal increased renal uptake, usually unilateral, of /sup 99m/Tc-polyphosphate. All had documented metastatic squamous cell carcinoma of the lung. The combination of focal increased renal /sup 99m/Tc-polyphosphate uptake with normal intravenous urogram occurred in no other patients. (auth)

14730 COMPARATIVE STUDY OF CONTRAST DACRYOCYSTOGRAM AND NUCLEAR DACRYOCYSTOGRAM. Chaudhuri, T. K.; Saparoff, G. R.; Dolan, K. D.; Chaudhuri, T. K. (Eastern Virginia Medical School, Hampton). J. Nucl. Med.; 16: No. 7, 605-608(Jul 1975).

A comparative study was run between conventional radiographic contrast dacryocystogram and radioisotope scan of the lacrimal drainage apparatus (henceforth called "nuclear dacryocystogram"). A total of 20 contrast dacryocystograms (DCG), 22 irrigations, and 42 nuclear dacryocystograms (DCG) were performed in 21 patients having symptoms of obstruction in the lacrimal drainage system. The study revealed that there was a good correlation between these two diagnostic techniques and nuclear DCG was, perhaps, superior to contrast DCG. (auth)

14731 GALLIUM-67 AND SUBPHRENIC ABSCESSES: IS DELAYED SCINTIGRAPHY NECESSARY. Hopkins, G. B.; Mende, C. W. (Scripps Memorial Hospital, La Jolla, CA). J. Nucl. Med.; 16: No. 7, 609-611(Jul 1975).

Forty postoperative patients with clinical and roentgenographic findings suggestive of subphrenic abscess were evaluated by early and delayed ^{67}Ga scintigraphy. Early ^{67}Ga scintigraphs obtained 6 hr after injection correctly localized seven right and five left subphrenic abscesses. In no instance was an abscess present on delayed scintigraphs that was not evident on the 6-hr study. Two patients with left subphrenic abscess had false-negative results on both early and delayed scintigraphy. No false-positive studies were recorded. Early ^{67}Ga scintigraphy can be a valuable noninvasive adjunct in the diagnosis of subphrenic abscess. (auth)

14732 SCINTIPHOTOGRAPHY IN DIAGNOSIS OF URINARY FISTULA AFTER RENAL TRANSPLANTATION. Haden, H. T.; Stacy, W. K.; Wolf, J. S.; Texter, J. H.; Thomas, F. T. (Veterans Administration Hospital, Richmond, VA). J. Nucl. Med.; 16: No. 7, 612-615(Jul 1975).

Scintiphotographic studies in six patients with ureteral fistula following renal transplantation are presented. Images were obtained using /sup 99m/Tc-Sn-DTPA or ^{131}I-orthoiodohippurate. Urinary leakage was accurately detected in each case but the pattern of extravasation is highly variable. When carefully performed, radionuclide scintiphotography is a safe and effective method for detecting urinary leakage after renal transplantation. (auth)

14733 RADIOISOTOPE MYELOGRAPHY IN DETECTION OF SPINAL FLUID LEAKS DUE TO DORSAL COLUMN STIMULATOR IMPLANTATION: CASE REPORT. Short, D. B.; Kirchner, P. T. (National Naval Medical Center, Bethesda, MD). J. Nucl. Med.; 16: No. 7, 616-618(Jul 1975).

Radioisotope myelography can be used effectively for the detection of spinal fluid leaks following surgical procedures involving the spine and spinal cord. The advantages of this approach are discussed in relation to currently used techniques and are illustrated by a case report. (auth)

14734 NUCLIDE ANGIOGRAPHY IN PAGET'S DISEASE OF THE SKULL: CASE REPORT. Fitzer, P. M. (Riverside Hospital, Newport News, VA). J. Nucl. Med.; 16: No. 7, 619-621(Jul 1975).

Early-appearing and persistent uptake on nuclear angiography in a patient with early Paget's disease of the skull is described. The diagnosis of subdural hematoma may be ruled out at the time of brain scanning. (auth)

14735 EFFECT OF OBSTRUCTED MEDIASTINAL VENOUS RETURN OF DYNAMIC BRAIN FLOOD FLOW STUDIES: CASE REPORT. Peart, R. A.; Driedger, A. A. (Univ. of Western Ontario, London). J. Nucl. Med.; 16: No. 7, 622-625(Jul 1975).

Three patients are described who had unusual isotope brain flow studies in which the injected isotope refluxed into the internal jugular vein, entered the transverse dural sinuses, and returned proximally to a variable extent through the contralateral internal jugular vein. Mediastinal flow studies revealed obstructed pathways of venous return in the upper mediastinum. One patient had lymphoma, another had had a pneumonectomy, and the third had no demonstrable disease process to explain the flow pattern. The internal jugular–cerebral system apparently permits reversal of flow in the presence of unilateral obstruction proximal to the internal jugular vein. (auth)

14736 VALUE OF HEPATIC SCINTIANGIOGRAPHY AND STATIC LIVER SCANS IN SUPERIOR VENA CAVAL OBSTRUCTION: CASE REPORT. Hughes, F. A. III. (General Hospital of Virginia Beach, VA). J. Nucl. Med.; 16: No. 7, 626-628(Jul 1975).

Isolated increased uptake of /sup 99m/Tc-sulfur colloid in a static liver scan with associated hepatic scintiangiography demonstration of collateral venous circulation is pathognomonic for superior vena caval obstruction. A case with these findings is reported and the differential diagnosis of hot spots occurring in liver scanning is discussed. (auth)

14737 IODINE-123-ROSE BENGAL: AN IMPROVED HEPATOBILIARY IMAGING AGENT. Serafini, A. N.; Smoak, W. M.; Hupf, H. B.; Beaver, J. E.; Holder, J.; Gilson, A. J. (Univ. of Miami, Miami Beach, FL). J. Nucl. Med.; 16: No. 7, 629-632(Jul 1975).

A practical method for preparing ^{123}I-rose bengal that allows for its rapid and efficient incorporation into the molecule is reported. Administration of ^{123}I-rose bengal to normal healthy patients showing the normal uptake and excretory pattern visualized with this radiopharmaceutical is also presented. The overall reduction in imaging time and radiation exposure together with the improved images possible should greatly improve our diagnostic capabilities in evaluating the jaundiced patient. (auth)

14738 ORGAN DISTRIBUTION OF /sup 99m/Tc- AND ^{51}Cr-LABELED THYMOCYTES. Barth, R. F.; Singla, O. (Univ. of Kansas, Kansas City). J. Nucl. Med.; 16: No. 7, 633-638(Jul 1975).

We have employed /sup 99m/Tc as a radioisotopic label to study the organ distribution of murine thymocytes. The compartmentalization of /sup 99m/Tc-labeled cells that had not been reduced by treatment with stannous chloride was similar to that of ^{51}Cr-labeled cells and was characterized initially by 48 to 50 percent uptake of the injected radioactivity by the lungs. Increased hepatic and splenic and decreased pulmonary localization were noted at 1 hr and these shifts were more pronounced by 4 hr. Technetium-99m-labeled cells reduced by stannous chloride had significantly different patterns of hepatic, pulmonary, and splenic localization and at 4 hr the lungs still retained 24 percent of the injected radioactivity compared with only 3 percent in the spleen. Size distribution studies revealed that unlabeled as well as unreduced and reduced /sup 99m/Tc-labeled thymocytes were almost identical to one another so that differences in compartmentalization could not be attributed to this factor. Since reduction with stannous chloride did not alter the distribution of ^{51}Cr-labeled cells, this suggested some type of complex interaction between stannous ions and the labeling species of /sup 99m/Tc. The in vivo localization of intravenously administered Na/sup 99m/TcO_4 and Na_2CrO_4 was markedly different from the corresponding radiolabeled cells thereby indicating that the distribution patterns that we observed truly represented cell-associated radioactivity. Although it may not necessarily be the proper reference point, the similarity in organ distribution of /sup 99m/Tc- and ^{51}Cr-labeled cells should allow direct comparison of previously reported data employing this radionuclide and that obtained in future studies with /sup 99m/-Tc. (auth)

14739 EVALUATION OF A RAPID AND SIMPLE TECHNIQUE FOR THE RADIOIMMUNOASSAY OF TRIIODOTHYRONINE (T_3). Burman, K. D.; Wright, F. D.; Earll, J. M.; Wartofsky, L. (Walter Reed Army Inst. of Research, Washington, DC). J. Nucl. Med.; 16: No. 7, 662-665(Jul 1975).

This report compares T_3 measurements obtained on the same serum samples by a resin-strip technique and by another existing radioimmunoassay method. The samples analyzed were obtained from a total of 90 subjects who were clinically categorized as hypothyroid, normal, hyperthyroid, or euthyroid while taking estrogen-containing compounds or while pregnant. The correlation coefficient for all 90 sera with these two different techniques was 0.94. All subjects who were clinically euthyroid (32) had a normal serum T_3 concentration by the resin-strip technique. Similarly, 23 clinically hyperthyroid patients had elevated serum T_3 concentrations and 15 of 17 clinically hypothyroid patients had decreased serum T_3 levels. (auth)

14740 NEW ADRENAL-SCANNING AGENT. Kojima, M.; Maeda, M.; Ogawa, H.; Nitta, K.; Ito, T. (Kyushu Univ., Fukuoka). J. Nucl. Med.; 16: No. 7, 666-668(Jul 1975).

A new adrenal-specific compound, 6beta-iodomethyl-19-norcholest-5(10)-en-3beta-ol (NCL-6-I), which is derived from 19-iodocholesterol (CL-19-I), has been found. Tissue distribution studies have revealed that the rat adrenal gland accumulates ten times more NCL-6-^{131}I than CL-19-^{131}I. The advantage of NCL-6-^{131}I as a possible adrenal-scanning agent is discussed. (auth)

14741 SCINTIGRAPHIC EVALUATION OF LIVER METASTASES FROM THYROID CARCINOMA. Woolfenden, J. M.; Waxman, A. D.; Wolfstein, R. S.; Siemsen, J. K. (LAC/USC Medical Center, Los Angeles). J. Nucl. Med.; 16: No. 7, 669-671(Jul 1975).

Thirty-one patients with carcinoma of the thyroid were evaluated using ^{131}I scan of the torso including the area of the liver. Focal areas of ^{131}I uptake were found in the liver in two patients with follicular thyroid carcinoma. Both patients showed associated abnormalities on /sup 99m/Tc-sulfur colloid liver scans. The remaining 29 patients showed either no uptake or a normal diffuse pattern of ^{131}I uptake in liver. Careful evaluation of the liver is recommended on the radioiodine body scan for metastases in patients with thyroid carcinoma. (auth)

14742 ABNORMAL BRAIN SCANS: CONTRIBUTION OF BLOOD RADIOACTIVITY TO IMAGE. Nahmias, C.; Webber, C. E.; Banna, M.; Garnett, E. S. (McMaster Univ., Hamilton, Ont.). J. Nucl. Med.; 16: No. 7, 676-678(Jul 1975).

Images obtained with /sup 99m/Tc-labeled red blood cells were compared with /sup 99m/Tc-pertechnetate scans in 26 patients with primary and secondary brain tumors, intracerebral infarcts, and hemorrhage. The results indicated that the contribution of blood pool radioactivity to a positive brain scan was minor. (auth)

14743 ELIMINATION OF SCALP BLOOD FLOW BY HEADBAND DURING DYNAMIC BRAIN SCINTIGRAPHY. Buhl, M.; Charles, P.; Jensen, F. T. (Aarhus Kommunehospital, Denmark). J. Nucl. Med.; 16: No. 7, 679-681(Jul 1975).

The effect of the application of a headband during brain scintigraphy was investigated in 11 healthy volunteers. In each person, extracranial recording of a bolus of /sup 99m/Tc-pertechnetate injected intravenously was done on two occasions using a scintillation camera. On one occasion a narrow sphygmomanometer cuff encircling the head from brow to occiput and inflated to 300 mmHg was applied during measurements; another time, the procedure was identical except for the headband. A comparison between counting rates under the derived time-activity curves showed significantly lower values on headband application ($p < 0.01$). Static scintigrams consisting of the first 300,000 counts recorded after bolus release with and without headband application show a clear delineation of the headband position with prevention of halo appearance about the cranial cavity. It has thus been possible by simple means to reduce the irrelevant radionuclide distribution which, especially during dynamic investigations of cerebral circulation, constitutes a source of error. (auth)

14744 ERYTHROCYTE SURVIVAL IN THE MONGOLIAN GERBIL. Dillon, W. G.; Glomski, C. A. (State Univ. of New York, Buffalo). J. Nucl. Med.; 16: No. 7, 682-684(Jul 1975).

Erythrocyte survival studies using ^{51}Cr- and $DF^{32}P$-labeling procedures were performed on the Mongolian gerbil, a recently discovered rodent used for medical research. Various isotopic techniques were performed and evaluated. (auth)

14745 RADIONUCLIDE IMMUNOGLOBULIN LYMPHANGIOGRAPHY: A CASE REPORT. Order, S. E.; Bloomer, W. D.; Jones, A. G.; Kaplan, W. D.; Davis, M. A.; Adelstein, S. J.; Hellman, S. (Harvard Medical School, Boston). Cancer; 35: No. 6, 1487-1492 (Jun 1975).

From 16th annual meeting of the American Society of Therapeutic Radiologists; Key Biscayne, FL (30 Oct 1974).

Iodine-131-labeled immunospecific gamma globulin derived from immunization of rabbits with Fantigen, a tumor associated antigen in Hodgkin's disease, has been utilized for intralymphatic infusion in a patient with known recurrent Hodgkin's disease in the inguinofemoral and pelvic regions. Rectilinear scanning successfully delineated the tumor masses, and external monitoring showed retention of activity in the tumor sites over an 8-day period. (auth)

MATERIALS

14746 (ORNL-RMIC-13) INTERNATIONAL DIRECTORY OF SOLID STATE MATERIALS PRODUCTION AND RESEARCH. Battle, G. C.; Connolly, T. F.; Keesee, A. M. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 171p. Dep. NTIS $11.75.

A directory is presented of organizations devoted to crystal production, starting material preparation, preparation of ultrapure noncrystalline materials, commercial supply, and research on properties of materials. (JRD)

14747 (ORNL-TM-4945) ESTIMATION OF GIBBS FREE ENERGY FUNCTIONS. Lindemer, T. B. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 21p. Dep. NTIS $4.25.

A computational method has been derived for the estimation of the molar heat capacity contribution to the Gibbs free energy function (fef) above 298°K. The method is based on the observed temperature invariance of certain ratios of the integrals of these molar heat capacity contributions. This method has been applied to the analysis of fef data for metal carbides, nitrides, fluorides, borides, and silicides in the crystalline state. The estimated fef for a given compound is more accurate than that obtainable by other known estimation techniques and permits a more accurate calculation of DELTAG^0/sub T/ than is possible from the commonly used approximation DELTAG^0/sub T/ equals DELTAH$^0_{298}$ - T DELTAS$^0_{298}$. (auth)

14748 CHEMICAL VAPOR DEPOSITION. Proceedings of the Fourth International Conference Held in Boston, Massachusetts, October 8–11, 1973. Wakefield, G. F.; Blocher, J. M. Jr. (eds.). Princeton, NJ; Electrochemical Society, Inc. (1973). 606p. (CONF-731017-).

From 4th international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973).

Forty-one papers and 5 extended abstracts are arranged into six chapters dealing with: fundamentals, techniques, electronic and semiconductor materials, tungsten, structures and structural materials, and coatings. Separate abstracts were prepared for 20 of the papers. (DLC)

For abstracts of individual papers see: 14768–14772, 14817–14829, 14886, and 14968.

14749 COVALENCY EFFECTS IN HYPERFINE INTERACTIONS. Sawatzky, G. A.; Van der Woude, F. (Rijksuniversiteit Groningen (Netherlands)). J. Phys. (Paris), Colloq.; No. 6, 47-60(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The effects of covalency and overlap distortion on the spin and charge densities in mainly ionic materials are discussed and related to the hyperfine interactions. A linear combination of atomic orbitals is used although expansions and contractions of the wave functions relative to the free ion wave functions are also considered. It is shown that the relevant charge transfer parameters can be obtained from a separate measurement of the supertransferred hyperfine magnetic field and a comparison of the total hyperfine magnetic field and the isomer shift. Also a relation between the supertransferred hyperfine field and the superexchange interaction is discussed and demonstrated. (FR)

14750 ON THE DIFFRACTION OF THE NUCLEAR RESONANT GAMMA-RAYS BY MOSAIC CRYSTALS. Chukhovskii, F. N.; Perstnev, I. P. (AN SSSR, Moscow. Inst. Kristallografii). J. Phys. (Paris), Colloq.; No. 6, 185-192(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

A diffraction theory of the resonant nuclear radiation diffraction by mosaic crystals in the presence of hyperfine splitting of nuclear levels is developed. The polarization tensor of the diffracted wave is obtained analytically. Particular attention is paid to the interference and polarization phenomena, which occur as a result of the birefringence and the non-orthogonality of the eigenwave polarization in a crystal containing resonant nuclei. Analytical expressions are obtained for determining the phase of the electronic scattering amplitude by the asymptotic solution of the integral equation which connects the experimental reflecting power $R_t(\nu)$ with the spectral scattering coefficient I_t(omega). (FR)

14751 TEXTURE PROBLEMS. Gonser, U.; Pfannes, H. D. (Universitaet des Saarlandes, Saarbruecken (F. R. Germany). Fachbereich Angewandte Physik). J. Phys. (Paris), Colloq.; No. 6, 113-120(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Texture is the preferred orientation of an assembly. The assembly may consist of crystals, molecules, spins, principal axes of EFG's at specific sites, etc. The influence of texture as an extrinsic (accidental) effect on the relative line intensities of a hyperfine pattern are analyzed and compared with the intrinsic effects (characteristic of the material) such as angular dependence of the hyperfine interaction and lattice vibrational anisotropy causing the Goldanskii–Karyagin effect, GKE. Correlation between texture and angular dependent Moessbauer parameters is discussed: 1) the orientation of the spins in a magnetic material or the principal axes of the EFG can be determined by correlating x-ray textures with the relative line intensities of the hyperfine pattern. 2) The reverse: the texture can be determined by analyzing relative line intensities of the hyperfine pattern by varying the propagation direction of the γ-radiation. 3) The main interest is focused on the correlation of GKE vs. texture. The GKE has become an important tool to determine lattice vibrational anisotropy; however, it is difficult to distinguish between these two competing effects. Examples are used to demonstrate the sensitive influence in the hyperfine pattern by texture, particularly, cases where a relatively small deviation from randomness produces the same effect on the relative line intensities as a relatively large lattice vibrational anisotropy. (FR)

Ceramics and Cermets

Refer also to abstracts 16204, 16261, 16262, 16266, 16299, 16632, 16636, and 16638.

14752 (AECL-4583) IRRADIATION-INDUCED STRUCTURE CHANGES IN REACTION BONDED SiC. McFadden, R. G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Mar 1975. 24p. Dep. NTIS (US Sales Only) $4.25. AECL $1.00.

Lattice parameter changes of the constituents in reaction-bonded silicon carbide have been measured as a function of neutron irradiation fluence up to (3×10^{25} n/m^2) (E > 1 MeV). α- and β-SiC expand isotropically with initial exposure but expansion levels out with continuing fluence. Free Si expands very slightly with irradiation. A computer program has been written to solve the precise lattice parameters for cubic and hexagonal crystals. (auth)

14753 (AED-CONF-74-089-055) SPECIFIC HEAT OF TANTALUM CARBIDE MICROCRYSTALS AT LOW TEMPERATURES. Roedhammer, P.; Gmelin, E.; Rieder, K. H. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (F. R. Germany)). 1974. 6p. (In German). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft e.V. of the Arbeitkreis Festkoerperphysik; Freudenstadt, F. R. Germany (1 Apr 1974).

The temperature-dependent course of the Debye temperature of the bulk of tantalum carbide, the surface contribution of the tantalum carbide microcrystals and the influence of the grain size of superconducting microcrystals on the course of the superconducting transition are investigated. (GE)

14754 (ANL-AFP-10) PHASE EQUILIBRIA AND MELTING POINT DATA FOR ADVANCED FUEL SYSTEMS. Fee, D. C.; Johnson, C. E. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 43p. Dep. NTIS $5.25.

Thermodynamic and phase equilibria data on UC, PuC, (U,Pu)C, UN, PuN, and (U,Pu)N systems and on these systems plus fission product elements are presented as a basis for predicting the chemical state of irradiated mixed carbide or mixed nitride fuel. Melting point data for the systems listed above are also given. (auth)

14755 (BNWL-SA-5244) THICK SPUTTER-DEPOSITED INSULATORS. Wang, R.; Dahlgren, S. D.; Laegreid, N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1975. 3p. (CONF-750542-2). Dep. NTIS $4.00.

From 77th annual meeting of the American Ceramic Society; Washington, District of Columbia, USA (3 May 1975).

Preparation of sputtered coatings of Al_2O_3, Y_2O_3, and AlN is described. The Al_2O_3 deposits showed an x-ray diffraction pattern characteristic of an amorphous structure. The Y_2O_3 deposits showed an x-ray diffraction pattern characteristic of cubic lattices. The AlN deposits were stoichiometric single-phase. (JRD)

14756 (FRNC-TH-515) RMN STUDY AND THEORY OF THE MAGNETIC FIELD DISTRIBUTION IN SECOND KIND SUPERCONDUCTORS. Delrieu, J. M. (Paris-11 Univ., 91 - Orsay (France)). 1974. 241p. (In French). INIS.

Magnetic field measurement inside the vortex structure by nuclear magnetic resonance in relatively impure niobium, powdered vanadium, alloys of lead, indium, and thallium in different forms is described. Nuclear magnetic resonance is used for the first time to measure the speed of vortices from the narrowing of the NMR band caused by their movement. From this it is possible to determine speed direction with respect to the vortex lattice. A complete theory of type II superconductors for all temperatures and purities, valid when the magnetization is much lower than the induction (i.e. for H(C) < H < H(C2), is then presented. The general properties of vortex lattices verified by all the order parameters are given, with special reference to those of their correlation functions. These new and rather strange properties have passed unnoticed in all theories. Physically, they correspond to effects of superconductor electron diffraction by the regular lattice of the vortex, an effect which has always been neglected because of the apparent destruction of the order parameter periodicity by its nonperiodic phase variations. Accounting exactly for the properties of the order parameter phase leads to new pseudo-periodicity formulae which represent the generalization of ordinary diffraction phenomena to the vortex lattice. It is shown that for the calculation of the static properties of thermal equilibrium the development used in the Brandt-Pesch Tewordt approximation is convergent and the approximations are good at zero order. On the other hand, the divergence of this development prevents a proper calculation of the dynamic properties and even of the state density for real frequencies. The magnetization of the superconductor is calculated by a much simpler formula. (FR)

14757 (JUL-1151-NC) X-RAY STUDIES OF THE MIXED CRYSTAL FORMATION IN THE SrO–EuO SYSTEM WITH THE DEBYE–SCHERRER POWDER TECHNIQUE. Guggi, D. J.; Ruetzel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nuklearchemie). Dec 1974. 33p. (In German). Dep. NTIS (US Sales Only) $4.75.

Mixed crystal formation in the binary system SrO–EuO was studied by x-radiography. The mixed crystal preparations were prepared from finely powdered and compacted mixtures of the pure initial phases by tempering for many hours at temperatures around 1150°C in a microautoclave with exclusion of air and moisture. The lattice parameters of the mixed phases formed were determined by measurement of the reflected ray region of Debye–Scherrer powder diagrams. The studies showed that the formation of mixed crystals occurs over the total composition range. The experimentally determined lattice parameters are somewhat smaller than that corresponding to the limit law for ideal solid solutions (Vegard's law). The results of this study should indicate possibilities for a stabilization of YbO in CaO as host lattice. (tr-auth)

14758 (LA-tr-75-22) IRRADIATION BEHAVIOR OF URANIUM NITRIDE. Zimmermann, H.; Dienst, W. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst fuer Material- und Festkoerperforschung). May 1975. Translation of KFK-EXT-6/74-1. 32p. Dep. NTIS $4.75.

Three irradiation capsules with annular UN pellets of an initial density of 95 percent TD and an UO_2 content of 5 to 10 vol percent were irradiated in the FR 2 reactor to 10, 20, and 30 MWd/kgU burnup at mean linear rod powers of about 900 W/cm. The capsules contained thermocouples in the fuel center and in the thick-walled molybdenum TZM cladding tube. The maximum fuel center temperature was measured to be 1800°C. The gap conductivity between UN and cladding was evaluated to be 0.5 $W/cm^2/°C$ at the beginning of the irradiation and later about 4 $W/cm^2/°C$ under high contact pressure. Radiation-induced sintering led to a fuel density of about 98 percent TD during the first 10 MWd/kgU burnup. In the burnup range of 20 to 30 MWd/kgU and at a mean fuel center temperature of 1250°C a swelling rate of about 5.5 percent/10 MWd/kgU and a breakaway fission gas release were found. (auth)

14759 (PEL-242) EFFECT OF MICROSTRUCTURE OF STAINLESS STEELS 304, 304L, AND 316 ON THE COMPATIBILITY BEHAVIOR WITH FINE URANIUM CARBIDE POWDERS. Stumpf, W. E.; Venter, S. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Feb 1975. 14p. Dep. NTIS (US Sales Only) $4.00.

Room-temperature embrittlement and precipitation behavior were studied in tensile test specimens of steels 304, 304L, and 316 that had been annealed in very fine uranium carbide powder. Variables that were introduced included the initial microstructure of the steel, temperature and time of annealing, and the fuel composition. Embrittlement was found in most cases, due to a heavy carbon buildup in the austenitic matrix, and in some cases even a subsequent transformation to a lamellar reaction product occurred. Carbon buildup, in the type of test employed, occurred rapidly during the initial stages of the test but later slowed down considerably. Generally the behavior of the fuel was found to be relatively insensitive to annealing temperature, microstructure, and alloy content of the steel and the composition of the fuel, although minor variations in behavior would suggest that a low-carbon or higher-alloy steel with a cold-worked structure, might perform marginally better in contact with stoichiometric UC than the other combinations investigated here. (14 figures) (auth)

14760 (PEL-243) EFFECT OF POWDER PARTICLE SIZE ON THE COMPATIBILITY BEHAVIOUR OF STAINLESS STEELS WITH URANIUM CARBIDE POWDER. Stumpf, W. E.; Venter, S. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Mar 1975. 11p. Dep. NTIS (US Sales Only) $4.00.

Compatibility tests between stoichiometric UC powders (with a wide range of BET specific surface areas) and stainless steels 304, 304L, and 316 were carried out at 600 and 700°C. It was found that UC powders obtained by crushing in a mortar and pestle, and with BET specific surface areas below 200 m^2/kg, do not carburise the stainless steels at all, whereas finer powders (BET values up to 1,000 m^2/kg) obtained by ball milling cause rather substantial carburisation of the steels after 1,000 h annealing time. It was further established that the transfer of carbon from the fuel to the cladding in this type of test occurs largely through the gas phase, and it is suggested that the surface oxidation of the very fine powders could be partly responsible for these observations. It is concluded that results from this type of compatibility test where UC powders are involved should be treated with caution, and probably cannot be compared with results obtained with solid fuel pellets. (auth)

14761 ENTHALPY OF NONSTOICHIOMETRIC URANIUM OXIDES AND SAPPHIRE TO 1500 K BY DROP CALORIMETRY. Marchidan, D. I.; Ciopec, M. (Centre of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 20: No. 2, 143-158(1975).

A precision drop calorimetric system was used to measure the enthalpy of $UO_{2.19}$, $UO_{2.34}$ and N. B. S. sapphire in the temperature range of 400 to 1500°K, relative to 298.15°K. All the temperatures are based on IPTS–68. Results of non-stoichiometric uranium oxides can be represented by the empirical equations which produce the best fit. A transition with an associated enthalpy increment of (1000 ± 65) J mol^{-1} occurs in the temperature range 855 to 865°K for $UO_{2.19}$ and two transitions with an associated enthalpy increment of (1500 ± 75) J mol^{-1} occur in the temperature range 860 to 870°K and 1335 to 1355°K respectively for $UO_{2.34}$. Values of $H^0(T) - H^0(298\ 15\ K)$, Cp, $S^0(T) - S^0(298.15\ K)$ and $S^0(T) - \{G^0(T) - H^0(298.15\ K)\}/T$ are tabulated. The sapphire results are used for determination of the calibration factor of the calorimetric block in comparison with the "electrical" calibration factor. (auth)

14762 HOT PRESSING AS A PRODUCTION PROCESS IN NUCLEAR TECHNOLOGY. de Freitas, C. T. (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo); 27: No. 166, 661-664(Sep 1971). (In Portuguese).

The potential of the hot pressing process for industrial applications is discussed. Emphasis is given to the hot-forming of actinide oxides of interest in nuclear technology; their densifications and microstructures are analyzed. (INIS)

14763 RELAXATIONAL POLARIZATION AND DIFFUSE PHASE TRANSITIONS OF La-SUBSTITUTED $Pb(Zr,Ti)O_3$-CERAMICS. Wolters, M.; Burggraaff, A. J. (Twente Univ. of Tech., Eschede, Netherlands). Mater. Res. Bull.; 10: No. 5, 417-424(May 1975).

Dielectric properties of $(Pb,La)Zr_{0.55}Ti_{0.45}O_3$ ceramics were investigated as functions of temperature and frequency. The dielectric constant as a function of temperature can be represented over a considerable temperature interval by a quadratic law of the type: epsilon $^{-1}$ equals epsilon^{-1}/sub max/ + C(T-T/sub c/-')^2. The permittivity versus temperature curves are strongly broadened around T/sub c/' (where epsilon is at a maximum) and the dielectric behavior is at least partly of a relaxational nature. Interpretation of the dielectric behavior (broadening, frequency dependence, quadratic law) seems possible by assuming a distribution of local Curie temperatures, the standard deviation of which can be correlated with the La concentration. (auth)

14764 EFFECT OF COMPOSITION ON THE SUPERCONDUCTING TRANSITION TEMPERATURE IN NbN/sub x/O/sub y/. Roy, R.; Carcia, P. F.; Messier, R.; Rogowski, D. (Pennsylvania State Univ., University Park). Mater. Res. Bull.; 10: No. 5, 379-382(May 1975).

The existence of superconducting fcc, nitrogen-rich niobium oxynitride thin films is reported. The superconducting transition

temperature T/sub c/ is observed to increase as the composition approaches $NbN_{0.96}O_{0.02}$. (auth)

14765 GALLIUM CONCENTRATION EFFECTS ON MAGNETIC BUBBLE FILMS OF $EuTm_2(Fe,Ga)_5O_{12}$ GARNET GROWN BY LIQUID PHASE EPITAXY. Giess, E. A. (Watson Research Center, Yorktown Heights, NY); Davies, J. E.; Guerci, C. F.; Hu, H. L. Mater. Res. Bull.; 10: No. 5, 355-362(May 1975).

By varying the Ga concentrations x of EuTm$_2$Fe/sub 5-x/Ga/sub x/O$_{12}$ from x equals 0 to about 0.8, thin magnetic films supporting stable bubbles with diameters from 0.5 to about 8 mu m, respectively, are deposited epitaxially onto gadolinium gallium garnet substrates oriented (111). For low values of x, the Ga segregation coefficient is about 2 and it decreases slightly as x increases. Thus, films contain roughly twice as much Ga as the LPE fluxed melts in which they grow. Both the characteristic length and magnetic bubble stability factor (Q) increase rapidly with x and, to a lesser degree, so does the uniaxial anisotropy field H/sub A/ while both 4pi M and the uniaxial anisotropy K/sub u/ decrease. (auth)

14766 MAGNETIC ORDERING IN Ba_2MnReO_6. Khattak, C. P. (SUNY at Stony Brook, New York); Cox, D. E.; Wang, F. F. Y. J. Solid State Chem.; 13: 77-83(1975).

The ordered perovskite Ba_2MnReO_6 has been reported to be ferrimagnetic with a Curie temperature of 105^{0}K and a saturation moment of 3.9 mu/sub B/, consistent with antiparallel coupling of spin-only moments of the combination Mn^{2+}-Re^{5+}. Neutron diffraction studies on polycrystalline material have confirmed that the Mn and Re ions are completely ordered chemically. At 4.6^{0}K, two sets of magnetic peaks were observed, the stronger consistent with the ferrimagnetic model, and the weaker characteristic of antiferromagnetic ordering of the first kind, indicative of some canting of the moments in adjacent (001) planes. The moment on the Mn ion was found to be 4.8 mu/sub B/, but that on the Re ion was found to be less than 0.2 mu/sub B/ if a localized free-ion form factor is assumed. These results can be interpreted in terms of an extended spin density distribution due to covalent bonding in the ReO_6 clusters. (auth)

14767 X-RAY STUDIES OF THE α/β MISCIBILITY GAPS OF SOME PALLADIUM SOLID SOLUTION–HYDROGEN SYSTEMS. Wise, M. L. H.; Farr, J. P. G.; Harris, I. R. (Univ. of Birmingham, Eng.). J. Less-Common Met.; 41: No. 1, 115-127(Jun 1975).

A selection of hydrogenated palladium solid-solution alloys has been investigated by x-ray diffraction at room temperature. The convergence of the lattice spacings of the α and β phases within the α/β miscibility gaps was determined in order to give the critical composition for the closure of the miscibility gap at room temperature. The shape of the miscibility region showed considerable variation for the different alloy systems. The lattice expansion at the β_{mis} boundary exhibited an approximately linear variation with the electron concentration, and the lattice expansion at the α_{max} boundary was thought to be influenced by the solid-solution strengthening of the particular alloy system. A line-broadening effect was observed which was ascribed to a pre-precipitation phenomenon. (auth)

14768 CHEMICAL VAPOR DEPOSITION OF ZrC IN SMALL BORE CARBON-COMPOSITE TUBES. Wallace, T. C. (Los Alamos Scientific Lab., NM). pp 91-106 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Process conditions are described for the chemical vapor deposition of ZrC from the vapor phase consisting of zirconium tetrachloride, methane, hydrogen chloride, hydrogen, and argon over the temperature range 1320 to 1775^{0}K. From an analysis of the process conditions (initial composition of coating gas, axial temperature profile along the tubes, total pressure and length of deposition time), the subsequent ZrC coat thickness profiles and thermodynamic data, an equation expressing the variation of the axial rate of ZrC deposition is derived. This expression can be used for the estimation of process conditions required to yield a specified ZrC cost profile. Additionally, the variations of the chlorine and oxygen contents, the lattice parameter, the microstructure of the ZrC deposit and the coefficient of thermal expansion as a function of deposition temperature are described. (auth)

14769 KINETIC STUDIES OF THE SIMULTANEOUS CVD OF B_4C AND C. Fitzer, E.; Rohm, M. (Univ., Karlsruhe, Ger.). pp 133-134 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical depcsition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

The simultaneous CVD of B_4C and C from $BCl_3/CH_4/H_2$ at 1200 to 1700^{0}C was studied. Homogeneous as well as heterogeneous B_4C/C structures were obtained. The overall deposition rate of C is first order with an activation energy of 30 kcal/mole; the C yield reaches a max of 80 percent at 1400^{0}C. Separation of the deposits and their physical properties are discussed. (DLC)

14770 CVD BORON NITRIDE INFILTRATION OF FIBROUS STRUCTURES: PROPERTIES OF LOW TEMPERATURE DEPOSITS. Gebhardt, J. J. (General Electric Co., Philadelphia). pp 460-472 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

The pyrolytic infiltration of boron nitride and silica fibrous structures with boron nitride was investigated using the thermal decomposition of B-trichloroborazole (TCB) to provide the matrix surrounding felted and 4-directional braided constructions. The deposition precursor was generated on a continuous basis by the reaction between boron trichloride and ammonium chloride in a fixed bed reactor under conditions of total conversion of the trichloride: $3BCl_3 + 3NH_4Cl$ equals $B_3N_3H_3Cl_3 + 9HCl$. Deposition rates in boron nitride felt specimens varied between 8 and 28 mu m/h, depending on the distance from the exterior surface at the minimum deposition temperature used (1100^{0}C). Infiltration of 4-directional silica braids was poorer because of clogging of the fiber bundle surfaces and access paths to voids in the weave. Deposits prepared at 1100^{0}C and above were stable to moisture and consisted of glassy transparent materials which had no discernible x-ray diffraction pattern. Heat treatment of low temperature deposits in nitrogen at 1800^{0}C caused significant growth of the crystallites and the emergence of x-ray patterns characteristic of hexagonal boron nitride. Heat treatment in vacuum caused changes in the infrared spectrum which could be correlated with mass analyses of the gases evolved. Loss of hydrogen with amines predominated to about 1500^{0}C above which point the loss of nitrogen became significant. (14 figures) (auth)

14771 HIGH TEMPERATURE–LOW DENSITY ZrC INSULATORS MADE BY CHEMICAL VAPOR DEPOSITION. Driesner, A. R.; Storms, E. K.; Wagner, P.; Wallace, T. C. (Los Alamos Scientific Lab., NM). pp 473-497 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

This paper describes the development of porous ZrC as an insulator for high-temperature, gas-cooled reactors. ZrC/sub x/ is a stable, single-phase carbide in the region 0.98 greater than or equal to x greater than or equal to 0.59. The thermal conductivity of ZrC/sub x/ is very sensitive to the vacancy concentration in the carbon sublattice (i.e. $1-x$). To decrease the value of the thermal conductivity of ZrC/sub x/ sufficiently to make the insulator, the carbon–zirconium ratio was decreased to an optimum value and the thermal conductivity decreased further by introduction of porosity in the ZrC/sub x/ matrix. By these techniques, the thermal conductivity of ZrC/sub x/ at 300 K was decreased from 50 W m^{-1} K^{-1} to less than 1 W m^{-1} K^{-1}. ZrC/sub x/ of 65 to 85 percent porosities were investigated and their properties measured. The production material was a 70 percent porous, fiber based ZrC/sub x/ which had satisfactory strength, thermal stress resistance, insulating power, and uniformity. This paper deals with the details of the fabrication and evaluation of the porous ZrC/sub x/ which was made for the reactor applications. (12 figures, 3 tables) (auth)

14772 CONTINUOUS CVD PROCESS FOR COATING FILAMENTS WITH TANTALUM CARBIDE. Heffernan, W. J.; Ahmad, I.; Haskell, R. W. (Watervliet Arsenal, NY). pp 498-508 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Coating parameters for the chemical vapor deposition (CVD) of TaC on a continuous tungsten filament for use in Co-base metal matrix composites have been determined. The process involves the in situ formation of $TaCl_5$ from Ta using either HCl or Cl_2 and the reaction of this compound with CH_4 on a resistively heated filament surface to form carbide. Results of the effects of temperature, gas composition, and flow rate on the nature of the deposit are discussed. Rates of deposition for Ta and C are contrasted to those measured for TaC. (auth)

14773 NIOBIUM–HYDROGEN SYSTEM: AN ELECTRON MICROSCOPE STUDY. I. Room Temperature Results. Schober, T. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi A.; 29: No. 2, 395-406(16 Jun 1975).

The room temperature morphology of β- and δ-phase precipitation in the NbH system is investigated under ultrahigh purity conditions (uhv degassed Nb and electrolytic charging). The β-phase ($NbH_{0.7}$ in the two-phase region) precipitated after electrolytic charging at room temperature in the form of large, dendritic particles. Charging at 150°C mainly results in plates on {100}. The presence of domain boundaries, antiphase boundaries, and twins in such precipitates is demonstrated. Evidence for extensive plastic deformation in β-phase areas is obtained and possible reasons for this are discussed. δ-phase (fcc NbH_2) precipitation occurs in the form of plates on {210} inside the β-phase. Observations are presented on the β- and δ-phase morphology for concentrations of up to 200% (= H/Nb). The main reasons for hydrogen embrittlement in highly charged NbH samples are described. (9 fig) (auth)

14774 REINTERPRETATION OF SMOKY QUARTZ. Nassau, K.; Prescott, B. E. (Bell Telephone Labs., Murray Hill, NJ). Phys. Status Solidi A.; 29: No. 2, 659-663(16 Jun 1975).

By appropriate irradiation and heat treatment some natural and synthetic quartz can be made blue, green, or greenish-yellow. In some of these samples, the A_1 and A_2 optical absorption bands usually assigned to the smoky color are present without any smoky coloration being evident. On further irradiation there develop: 1. the smoky color; 2. a previously unrecognized absorption band at 2.9 eV (designated A_3); and 3. an EPR signal due to the substitutional Al center. Therefore, the smoky color originates in the A_3 absorption band. The absorption curves can be reproduced in detail with five Gaussian components, clearly demonstrating the presence of A_1 (at 1.85 eV), A_2 (2.55 eV), A_3 (2.90 eV), B (3.95 eV)–previously reported only in fused silica), and C absorption bands. (auth)

14775 INVESTIGATION OF THERMOSTIMULATED PHENOMENA OF THE DYSPROSIUM ION IN YTTRIUM–ALUMINIUM (YAG) AND DYSPROSIUM–ALUMINIUM (DAG) GARNET LATTICES. Antonov, V. A.; Arsenev, P. A. (Inst. of Energetics, Moscow). Phys. Status Solidi A.; 29: No. 2, 645-650(16 Jun 1975).

Assumptions are examined of using Dy^{2+} as active ion of garnet optical generators pumped by ionizing irradiation. The defective structure of YAG:Dy and DAG is investigated using thermostimulated currents and thermostimulated luminescence by different methods. Results are discussed. (auth)

14776 PHOTOELASTICITY OF GADOLINIUM MOLYBDATE. Martynov, V.G.; Aleksandrov, K.S.; Anistratov, A.T.; Polkhovskaya, T.M. (Institute of Physics, Siberian Branch, Academy of Sciences of the USSR). Sov. Phys.–Crystallogr. 19: No. 6, 753-754 (May 1975).

The temperature dependence of the photoelastic coefficients p_{33}, p_{13}, p_{11}, and p_{12} of gadolinium molybdate in the region of T_C has been studied. The coefficient of acoustooptical quality M_2 has been estimated. The behavior of the photoelasticity of $Gd_2(MoO_4)_3$ has been discussed and compared with classical ferroelectric crystals. (auth)

14777 RECENT DEVELOPMENTS IN THE FIELD OF HARD MATERIALS AND HARD METALS. Kieffer, R.; Ettmayer, P. (Technische Hochschule, Vienna (Austria). Inst. fuer Chemische Technologie Anorganischer Stoffe). Chem.-Ing.-Tech.; 46: No. 20, 843-852(Oct 1974). (In German).

From meeting on hard materials; Lindau, F. R. Germany (5 Apr 1973). 21 figs.; 7 tabs.; 55 refs.

Developments of the past four years in the area of hard materials and hard metals are briefly commented upon. Novel HfC- and NbC-containing hard metals based on WC, and WC-free hard metals based on (Ti,Mo)C and titanium carbonitride have proved of value in practice, while hard metals based on TaN are still in the experimental stage. Cast carbides from the TiC–W system appear particularly suitable for heavy cutting. Coating of hard metal alloys with layers of carbide, and especially nitride, has already attained technical importance. Sintered polycrystalline diamond tools obtained under the conditions of diamond synthesis are especially suited to the machining of brittle, difficultly workable materials. Attrition grinding of hard metals for production of ultrafine grain structure, spray drying of the ground materials, and particularly hot-isostatic compression of hard metals characterize the current state of technology. (GE)

14778 PROCESS FOR THE PRODUCTION OF CERAMIC NUCLEAR FUEL PELLETS. (to British Nuclear Fuels Ltd., Capenhurst). French Patent 2,214,157/A/. 11 Jan 1974. 9p. (In French).

14779 VAPOR DEPOSITS OF ORIENTED NIOBIUM AND TANTALUM DIBORIDES. Armas, Benigno; Trombe, Felix (Centre National de la Recherche Scientifique, 66- Montlouis (France). Lab. de l'Energie Solaire). C. R., Ser. C.; 280: No. 7, 435-438(17 Feb 1975). (In French).

The experimental conditions for obtaining NbB_2 and TaB_2 oriented according to the C axis are described. The reaction is the thermal dissociation of niobium or tantalum pentabromide plus boron tribromide mixture. Heating is provided by the concentration of solar radiations. Experimental parameters are: temperature, 1,400°C; pressure, 2.5×10^{-2} torr halogenides flow, 200 to $400 cm^3.h^{-1}.cm^{-2}$. A columnar structure is obtained with little lateral cohesion, and with the cleavage plane parallel to the substratum surface. For halogenide flow less than that indicated hexagonal microcrystals form of a size from 15 to 20 μm. (FR)

14780 TECHNICAL USE OF BORON COMPOUNDS. von Matuschka, A. (Elektroschmelzwerk Kempten G.m.b.H., Muenchen (F. R. Germany)). Chem.-Ztg., Chem. App.; 98: No. 10, 499-504(Oct 1974). (In German).

3 figs.; 4 tabs.; 40 refs.

The technical applications of boron compounds such as boron carbide, boron halides, boron nitride, titanium boride, zirconium boride, calcium hexaboride and europium hexaboride are described. Boron carbide is used in grits and in sintered form for grinding and lapping because of its great hardness. Because of its high absorption cross section, it is used as a neutron absorber in atomic power stations, and as control and shield material. Sintered boron carbide is used for example in the form of nozzles, mortars, or armor plates. As a source of boron, it is used in boriding compounds to produce extremely hard and wear-resistant surface layers. Boron halides are used for doping semiconductors and as raw material for the production of boron threads. Boron nitride is becoming more important for example as high temperature material, as electrical insulating and crucible material, as a neutron absorber and in the form of wafers. Metal borides are employed e.g. as high temperature material, as electrode material, as a deoxidizing and fluxing agent and as an absorber in fast breeding reactors. Many boron compounds are used in compound sinter parts, for example as thermocouple shield tubes or as evaporation boats in high vacuum metallization. (auth)

14781 CONTRIBUTION TO THE STUDY OF THE SYSTEM UO_3-V_2O_5-Na_2O: DETERMINATION PROPERTIES AND INVESTIGATION OF THE SOLID PHASES. Dion, Christian (Lille-1 Univ., 59- Villeneuve-d'Ascq (France)). Bull. Soc. Chim. Fr.; No. 12, 2701-2708(Dec 1974). (In French).

Seven new phases are described: $NaUO_2VO_4$, $Na[UO_2(VO_3)_3]$, $NaUV_7O_{21}$, NaU_2VO_9, $12UO_3$ -$3V_2O_5$ - $1Na_2O$ and $Na_xV_xU_{1-x}O_3$ (where $0.70 \leq x \leq 0.80$ and $0.86 \leq x \leq 0.90$. The reduction of these phases with H_2 and H_2S gives four new intermediate compounds: $NaUVO_{5+x}$ $0 \leq x \leq 0.30$, $NaUV_3O_{10}$, $NaUV_3O_{11}$ and $Na_4UV_6O_{14}$ in which uranium is present as U^{4+} and vanadium as V^{5+}. (FR)

14782 E.M.F.-MEASUREMENTS IN OXYGEN-Va METALS-SYSTEMS USING A ThO_2-Y_2O_3 SOLID ELECTROLYTE. Fromm, E.; Kirchheim, R. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Werkstoffwissenschaften). Z. Metallkd.; 66: No. 3, 144-150(Mar 1975). (In German).

11 figs.; 22 refs.

The terminal solubility of oxygen in vanadium and tantalum was measured from 600 to 1,100°C using a ThO_2–Y_2O_3 solid electrolyte. The validity of Henry's law for oxygen dissolved in V, Nb, and Ta was demonstrated for the whole α-phase region. In the quenched Ta–O specimens a plate-like, metastable tantalum oxide was formed, transforming at 1,000°C into the stable Ta_2O_5 having a free enthalpy of formation of 300 to 500 cal/mol O above the value for Ta_2O_5. In the V–O system, e.m.f. measurements were made up to oxygen concentrations of 30 at%. For α-V the relation given holds and the free enthalpy of formation of the β-phase was found to be $\Delta G^0 = -103{,}000 + 21.1\ T$(cal/mol, K). (auth)

14783 ION IMPLANTATION. Dearnaley, G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Vide; 29: No. 174, 401-406(Nov 1974).

The physical mechanisms involved in ion implantation are considered. A series of important semiconductor device structures are considered in turn, to illustrate how implantation has brought about improvements in yield and performance: MOS transistors, MOS integrated circuits, bipolar transistors, high value resistors diodes, and compound semiconductors. Equipment for ion implantation is briefly detailed. The possibilities that lie ahead for ion implantation are discussed. (FR)

14784 VIBRASOL: A NEW TECHNIQUE FOR THE MANUFACTURE OF FISSILE FUELS. Sens, P. F. Atoomenerg. Haar Toepass.; 17: No. 5, 112-119(May 1975). (In Dutch).

The Vibrasol method consists of a method to produce a more uniform dispersion of fissile fuel matrix in a ceramic matrix than has previously been possible. Work at RCN (Petten) is especially of interest. Typical spheroids have a mean diameter of 5 microns and of (Th,U) O_2, formed in a urania matrix of 99% theoretical density. Results of irradiation experiments are described, a typical case (B-72) achieving a linear rating of 645 W/cm. Production capacity of the "Interfuel" agency is noted. (GC)

14785 SELF-DIFFUSION OF OXYGEN IN POLYCRYSTALLINE $MgAl_2O_4$. Oishi, Y.; Ando, K. (Department of Nuclear Engineering, Kyushu University, Fukuoka, Japan). J. Chem. Phys. 63: No. 1, 376-378 (1 July 1975).

Self-diffusion coefficients of oxygen in polycrystalline $MgAl_2O_4$ were determined over the temperature range 1310–1694 °C by a gas–solid isotopic exchange technique using ^{18}O as a tracer and the results were compared with those of single crystal $MgAl_2O_4$. The apparent diffusion coefficients for the polycrystal were greater than those of the single crystal. These results were interpreted as being due to oxygen diffusion enhanced by grain boundaries. (auth)

14786 THERMIONIC EMISSION PROPERTIES OF ZIRCONIUM, HAFNIUM, AND TITANIUM NITRIDES IN CESIUM VAPOR. Eremeev, M.A.; Neshpor, V.S.; Novikov, A.B.; Stefanovskaya, E.M.; Fedorinov, V.P. (M. I. Kalinin Leningrad Polytechnical Institute). Sov. Phys.–Tech. Phys. 19: No. 10, 1337-1341 (Apr 1975).

The thermionic emission of zirconium, hafnium, and titanium nitrides in vacuum and in cesium vapor is studied when the flux density of cesium atoms varies from $4\cdot10^{14}$ to 10^{18} $cm^{-2}\cdot sec^{-1}$. The emitters acquire new stable thermionic emission properties as a result of a long exposure in cesium vapor. The work function of these materials in the high-temperature region is reduced considerably as compared with the values obtained before exposure to cesium vapor. There are reasons to believe that cesium incorporated into the volume of the nitride exists there in a chemically combined state. (auth)

14787 OPTICAL PROPERTIES OF LAYERS OF OXIDE MIXTURES PRODUCED BY CATHODE SPUTTERING. Motovilov, O.A.; Rudina, O.G. Sov. J. Opt. Technol. 41: No. 6, 327-330 (June 1974).

A method of making thin layers of mixtures of tantalum, niobium, zirconium, and titanium oxides with silicon dioxide is discussed. A formula is given for calculating the ratio of the volume concentrations of the components from a given value of the refractive index of the layer. Layers with n values within the interval 1.47–2.5 have been obtained. A sharp reduction in the light diffusivity of the layers is observed when silicon dioxide is added. The optimum mixture compositions are established for maintaining a high index of refraction with a low level of light scattering. (auth)

14788 METAL-INSULATOR TRANSITION IN VANADIUM DIOXIDE. Zylbersztejn, A. (laboratorie Central de Recherches, Thomson-C.S.F., 91401 Orsay, France); Mott, N.F. Phys. Rev. B 11: No. 11, 4383-4395 (1 June 1975).

The basic physical parameters which govern the metal-insulator transition in vanadium dioxide are determined through a review of the properties of this material. The major importance of the Hubbard intra-atomic correlation energy in determining the insulating phase, which was already evidence by studies of the magnetic properties of $V_{1-x}Cr_xO_2$ alloys, is further demonstrated from an analysis of their electrical properties. An analysis of the magnetic susceptibility of niobium-doped VO_2 yields a picture for the current carrier in the low-temperature phase in which it is accompanied by a spin cloud (owing to Hund's-rule coupling), and has therefore an enhanced mass ($m \simeq 60m_0$). Semiconducting vanadium dioxide turns out to be a borderline case for a classical band-transport description; in the alloys at high doping levels, Anderson localization with hopping transport can take place. Whereas it is shown that the insulating phase cannot be described correctly without taking into account the Hubbard correlation energy, we find that the properies of the metallic phase are mainly determined by the band sturcture. Metallic VO_2 is, in our view, similar to transition metals like Pt or Pd: electrons in a comparatively wide band screening out the interaction between the electrons in a narrow overlapping band. The magnetic susceptibility is described as exchange enhanced. The large density of states at the Fermi level yields a substantial contribution of the entropy of the metallic electrons to the latent heat. The crystalline distortion removes the band degeneracy so that the correlation energy becomes comparable with the band width and a metal-insulator transition takes place. (auth)

14789 ALTERNATIVE FORM OF THE NONLOCAL *p* POTENTIAL IN THE EMPIRICAL PSEUDOPOTENTIAL METHOD. Fong, C.Y. (Department of Physics, University of California, Davis, California 95616); Chadi, D.J.; Cohen, M.L. Phys. Rev. B 11: No. 10, 4063-4064 (15 May 1975).

An alternative nonlocal *p* potential is suggested. The difference between the present and the earlier form are discussed in terms of the effectiveness on the *p* states of the elements in the first row of the Periodic Table. (auth)

14790 PARTIAL DENSITY OF STATES OBTAINED FROM APW BAND STRUCTURE CALCULATIONS FOR NbC AND NbN. Schwarz, K. (Technische Hochschule, Vienna). J. Phys., C (London); 8: No. 6, 809-813(21 Mar 1975).

The APW (augmented-plane-wave) energy bands are fitted using the Slater-Koster LCAO method. With this interpolation scheme partial densities of states are derived which allow an interpretation of the binding mechanism of NbC and NbN. These compounds are shown to be d-type superconductors. (auth)

14791 EFFECTS OF ELECTRON RADIATION AT 80 K ON TERNARY SEMICONDUCTORS CONTAINING TELLURIUM. Naber, J. A.; Leadon, R. E.; Harper, H. T.; Green, B. A.; Mallon, C. E. (Intelcom Rad Tech, San Diego, CA). pp 325-331 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The introduction and annealing of electron-produced damage in PbSnTe and HgCdTe are used to develop models for the irradiation-produced defects in alloy semiconductors. Irradiation-produced changes in the carrier concentration, mobility and apparent band gap are measured at 80°K, with isochronal annealing to 350°K. A model for both donor and acceptor introduction is proposed to explain the observed radiation and annealing changes in ternary semiconductors containing tellurium. (auth)

14792 STRAIN MEASUREMENTS IN AND ON BORON–EPOXY TEST COUPONS. Egger, R. L. (Boeing Aerospace Co., Seattle); Mullineaux, J. L. (USAF Flight Dynamics Labs., Wright-Patterson AFB, OH). Exp. Mech.; 15: 35-40(Jan 1975).

A program to evaluate strain gages embedded in boron-epoxy test coupons is described. The strain gages, embedding techniques and specimen configurations used were relatively uncomplicated. The results of the program showed that the embedded-gage performance was comparable to surface-mounted-gage performance and are intended to provide a basis for more complex applications such as in joints, near holes, and in sandwiched metal/fibrous composites. (IAA)

Metals and Alloys

14793 (UCRL-Trans-10716) HIGH RESOLUTION ELECTRON-MICROAUTO-RADIOGRAPHY APPLIED TO METALLURGY. Laurent, J. P.; Lapasset, G. Translated from Int. J. Appl. Radiat. Isot.; 24: 213-230(1973). 42p. Dep. NTIS $5.25.

High-resolution autoradiography is able to localize radioactive traces in metals with reference to the structural defects. The sensibility of available emulsions is sufficient to detect very low concentrations (less than 0.01 ppM) in reasonable exposure times (1 day to 1 month), especially as the radiotracer is segregated on structure defects. The resolution limit is about 3000Å for strongly ionizing emitters, as tritium (18 keV). It becomes 4 to 10 μm when the radioisotope emits stronger electrons (^{14}C: 155 keV) depending on the nature and the position in the metal of the source. Precautions must be taken if concentrations are to be measured by this method. Quantitative results are still uncertain but they bring information that cannot be brought by any other technique. Difficulties in the interpretation of autoradiographs and artefacts detection can be generally removed by control experiments on non-active specimens submitted to the same procedure as radioactive specimen. (23 figures) (auth)

Corrosion and Erosion

Refer also to abstracts 14759 and 14760.

14794 (AED-CONF-74-649-001) THE INHIBITION OF COOLANT LOOPS. Weber, J. (Sulzer Bros. Ltd., Winterthur (Switzerland)). 1974. 23p. (In German). INIS.

From colloquium on corrosion protection with the tid of inhibitors; Frankfurt am Main, F. R. Germany (28 Nov 1974).

The possibilities of the treatment of coolant loops for corrosion inhibition in highly stressed cooling systems is discussed. The influence of the cooling-water velocity, the thermal stress or metal wall temperatures, lubricating action of cooling liquids, inhibition of corrosion fatigue and the cavitation, interactions

between inhibition and cathodic protection, and the choice of inhibitors and their control in operation, are all dealt with. (GE)

14795 (BARC-777) THERMODYNAMICS OF SACRIFICIAL DEOXIDATION OF REFRACTORY METALS. Garg, S. P.; Sundaram, C. V. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

Sacrificial deoxidation via suboxide evaporation at high temperature and vacuum is one of the most important techniques for the purification of many refractory metals. A theoretical thermodynamic approach was used to assess and examine the deoxidation tendencies of refractory metals of Groups IV and V. Based on the thermodynamic data available for gaseous suboxides and reported or estimated values of oxygen activities in the metals, vapor pressures of suboxides were calculated and plotted as a function of temperature and the oxygen content of the metal. From these data it was possible to estimate (1) the extent of deoxidation, (2) the vaporization loss of metal during deoxidation, and (3) the rate of deoxidation. Calculations were also made for ternary systems such as Nb–Zr–O and Ta–Hf–O and compared with experimental values based on the experimental observations. (auth)

14796 (EURFNR-1206) SPECTROCHEMICAL STUDY OF CORROSION OR DIFFUSION ZONES OF CORRODED CLADDING MATERIALS USING A GLOW DISCHARGE LAMP. Schneider, H.; Schumann, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jul 1974. Translation of KFK-2009. 46p. Dep. NTIS $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A spectrochemical method is described for the analysis of corrosion- or diffusion zones. The excitation and the removal are effected by a glow discharge lamp (Fa. RSV) over a spherical area of 8 mm diameter. Using this method cladding tube samples of stainless steel Nr. 1.4970, 1.4988 and 1.4981 were analyzed after corrosion in sodium. Preliminary investigations were made by a quartz-spectrograph 110 M (Fa. Fuess) and the concentration levels of Cr, Ni, and Mn in the surface layers were determined. Further investigations were carried out using a vacuum spectrometer with stationary slits for about 10 elements (Fe, Cr, Ni, Mn, Co, Nb, Ti, Mo, V, B, and C) and automatic measurement of the intensities. Precise working instructions are described and discussed. The concentration profiles of the elements in the diffusion zones of corrosion samples after exposure in sodium at 700°C are plotted. (auth)

14797 (ORNL-5031) COMPARATIVE RESULTS ON CHLORIDE STRESS CORROSION CRACKING OF STEAM GENERATOR MATERIALS IN CYCLIC STEAM ENVIRONMENT. Hammond, J. P.; Patriarca, P.; Slaughter, G. M.; Maxwell, W. A. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 34p. AT.

A field test was developed for evaluating steam generator materials for resistance to chloride stress-corrosion cracking (SCC) under cyclic wet-dry (dry-rot) steam conditions. The method of test was qualified by establishing the specific environmental conditions to which test surfaces were exposed, and the mounted specimens were appraised for relaxation of stress during exposure. The materials tested were rated in three classes relative to resistance to chloride SCC. Materials that resisted cracking included various nonwelded and welded ferritic steels with chromium levels from 2¼ to 12%. Post-weld annealing was essential to impart crack resistance to 9 Cr-1 Mo, 12 Super Cr, and possibly stabilized 2¼ Cr-1 Mo. Other materials resisting cracking included Inconel 625 welded with itself and nonwelded Inconel 625, Inconel 601, Inconel 690, Incoloy 809E, Hastelloy C-276, and Hastelloy G. Materials with slight to moderate susceptibility to cracking included weldments in Incoloy 800 and Inconel 600 joined with Inconel 82 and IN-102, Hastelloy X, and Hastelloy S welded with themselves. Also included in this category are a number of austenitic stainless steels examined nonwelded. Materials with high susceptibility to cracking included type 304 stainless steel welded with type 308 and Hastelloy N and electron-beam-melted 26 Cr–1 Mo steel welded with themselves or not welded. Increasing chromium content in nickel-base alloys in the range of 7.5 to 37% appeared to improve resistance to chloride SCC. (8 tables, 8 fig) (auth)

14798 (RD/B/N-3232) SIMPLE THERMAL SYPHON SODIUM LOOPS. Gwyther, J. R.; Marshall, P.; Rowe, D.; Withrington, D. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1974. 10p.

The design, construction, commissioning and operation of small-scale thermal syphon loops is described. The loops operate within the temperature range of 120 to 700°C, with sodium flow rates of a few cms. sec^{-1} and sodium inventories of 300g. The sodium chemistry is monitored by a cold trap and a carbon meter. (auth)

14799 (TID-22353) AEC–NASA LIQUID METALS INFORMATION MEETING, GATLINBURG, TENNESSEE, APRIL 21–23, 1965. (Oak Ridge National Lab., Tenn. (USA)). 1965. 117p. (CONF-650411–). Dep. NTIS $9.00.

From joint NASA–AEC liquid metals corrosion meeting; Gatlinburg, Tennessee, USA (21 Apr 1965).

Declassified 30 Aug 1973.

Survey papers are presented on mass transfer in refractory metal alloys, use of Li and Na reactor coolants, corrosion of refractory metals in Li, and corrosion in simulated metal cooled reactor systems. (JRD)

14800 (UCRL-Trans-10886) INVESTIGATION OF THE KINETICS OF THE INTERACTION OF NIOBIUM WITH VARIOUS GASES AT LOW PRESSURES AND HIGH TEMPERATURES. Lein, F. Ya.; Ermakova, M. P.; Nesterenko, A. G.; Martinson, E. N.; Gekov, A. F.; Arakelov, A. G. Translated from Fiz. Khim. Obrab. Mater.; No. 5, 27-31(1974). 11p. Dep. NTIS $4.00.

The interaction of niobium with residual gases in a vacuum taken separately in relatively pure form and in the form of mixtures at pressures of 1×10^{-4} and 1×10^{-5} mm Hg and temperatures ranging from 400 to 1200°C is discussed. It is shown that at the initial linear segment of the kinetic curve the velocity of interaction of niobium with gases increases in the following order: nitrogen, carbon monoxide, water vapor, air, a mixture of 50% nitrogen and 5% oxygen, and oxygen. The reaction coefficients were determined under these conditions. It is shown that the retarding effect of a passive gas (nitrogen) amounts to a decrease of the partial pressure of the active gas (oxygen). (auth)

14801 (USNRDL-TR-67-109) SEAWATER CORROSION STUDIES OF EMISSIVELY-COATED HAYNES-25; RADIOACTIVE TRACER TECHNIQUES. Kubose, D. A.; Goya, H. A.; Lai, M. G.; Cordova, H. I. (Naval Radiological Defense Lab., San Francisco, Calif. (USA)). 19 Aug 1967. Contract AT(49-5)-2084. 30p. Dep. NTIS $4.50.

Corrosion rates of uncoated, half- and completely-emissively-coated Haynes 25 have been measured in seawater by use of radioactive tracer techniques. The corrosion rates observed for the (1) uncoated and (2) half- and completely-coated specimens were nominally 3×10^{-6} and 1×10^{-4} mil per year (mpy), respectively. It was established that the observed corrosion rates of the half- and completely-coated specimens were due entirely to corrosion of Haynes 25 and not to the corrosion of the emissive coating. The higher corrosion rates were attributed primarily to the fact that the actual surface area of the Haynes 25 was much larger than the geometric surface area because of surface preparation prior to application of the emissive coating. A re-examination of the corrosion rate based upon the amounts of cobalt and chromium released to the seawater indicated that the previously reported differential leaching of these components of Haynes 25 was an experimental artifact due to errors in counting extremely low amounts of chromium-51. Present observations show that the cobalt-and-chromium-based corrosion rates are the same and agree with the previous cobalt-based corrosion rate. (auth)

14802 (USNRDL-TR-67-142) EROSION–CORROSION OF HAYNES-25 ALLOY; RADIOACTIVE TRACER TECHNIQUES. Cordova, H. I.; Kubose, D. A. (Naval Radiological Defense Lab., San Francisco, Calif. (USA)). 21 Aug 1967. Contract AT(49-5)-2084. 28p. Dep. NTIS $4.50.

The erosion–corrosion caused by the washing of a mixture of seawater and ocean-bottom material across a specimen of Haynes-25 at ambient room temperature has been studied with radioactive tracer techniques. The results showed that the corrosion rate in such an environment is higher than the rate observed in seawater alone. (auth)

14803 RARE EARTH DIHYDRIDE FORMATION BY REACTION OF RARE-EARTH METAL THIN FILMS WITH WATER VAPOR. Dexpert-Ghys, J.; Loier, C.; La Blanchetais, C. H.; Caro, P. E. (CNRS, Meudon Bellevue, France). J. Less-Common Met.; 41: No. 1, 105-113(Jun 1975).

Rare-earth dihydride LnH_x ($x \cong 2$) formation was observed by the exposure of rare-earth-metal thin films to water vapor at fairly low temperatures. In the case of neodymium, this is accompanied by the slow formation of the hydroxide but, in the case of dysprosium, the hydride alone is obtained at about 413°K. There are no hydrated contaminants and the dysprosium thin films do not oxidize until a higher temperature (about 473°K) is reached. (auth)

14804 OXIDATION OF THIN MOLYBDENUM–RHENIUM FOILS. Witcomb, M. J. (Univ. of the Witwatersrand, Johannesburg). J. Less-Common Met.; 41: No. 1, 45-57(Jun 1975).

The oxidation of thin Mo_2Re foils under reduced pressure at

1290°K has been studied by hot-stage transmission electron microscopy. Preferential oxidation and evaporation of the molybdenum has been found to occur. With increasing heat-treatment time, a series of intermediate surface oxides appear, terminating in a cubic oxide of the form $Mo_3Re_7O_x$. The crystallographic orientation relationship observed between the matrix, M, and the cubic oxide, OX, was determined as $(111)_M//(111)_{OX}$; $[0\bar{1}1]_M//[0\bar{1}1]_{OX}$. Although globulization of the cubic oxide resulted in a fairly homogeneous distribution of oxide particles, these were restricted to the foil surface. Fracture was thus intergranular due to those oxide particles occupying grain boundaries sited. (auth)

14805 HYDRIDES OF PRASEODYMIUM–COBALT COMPOUNDS. Clinton, J.; Bittner, H.; Oesterreicher, H. (Univ. of California, San Diego, La Jolla). J. Less-Common Met.; 41: No. 1, 187-189(Jun 1975).

The finding of reversible room-temperature hydriding in $CaCu_5$-type compounds such as $LaNi_5$ prompted an investigation of whether similar effects are also observed in various related crystal structures. For this purpose the Co-rich portion of the system Pr–Co was chosen in which phases Pr_2Co_{17} (Th_2Zn_{17} type), $PrCo_5$ ($CaCu_5$ type), Pr_2Co_7 (Ce_2Ni_7 type), $PrCo_3$ ($PuNi_3$ type) and $PrCo_2$ ($MgCu_2$ type), have been reported. Of these compounds only $PrCo_5$ has been previously shown to form a hydride. Results show that only in a relatively-narrow region of composition, from $PrCo_5$ to $PrCo_3$, do the individual properties of rare earth and transition metals combine to offer suitable conditions for reversible hydride formation at about atmospheric pressure, and in the vicinity of room temperature. Heats of formation for these compounds lie between $\Delta H = -8$ and -13 kcal/mole H_2. Assuming Co, on hydrogen up-take, to exhibit small endothermic heats of reaction similar to Ni (about 2 kcal/mole H_2), then these values lie approximately on a line connecting the pure binaries. (PrH_3 has a value of $\Delta H = -49$ kcal/mole H_2.) A similar relationship applies to the amount of hydrogen up-take. From a materials-engineering point of view therefore, it appears, to a first approximation, that reversible room-temperature hydriding becomes possible at stoichiometries where the weighted heats of formation of the individual components add up to values of the order -8 kcal/mole H_2. The increasing values of P_e toward transition-metal-rich phases from $PrCo_2$ to $PrCo_5$ corroborate the decreasing thermodynamic stability of the hydride phases. Accordingly, it is reasonable to expect Pr_2Co_{17} to form hydrides at pressures beyond 100 atm. (auth)

14806 ELECTROCHEMICAL MEASUREMENT OF THE CREVICE CORROSION RESISTANCE OF STAINLESS STEELS. Crolet, J. L.; Defranoux, J. M.; Seraphin, L.; Tricot, R. (Ugine Aciers, 73- Ugine (France)). Mem. Sci. Rev. Metall.; 71: No. 12, 797-805(Dec 1974). (In French).

From 13th meeting on alloy steels; Saint-Etienne, France (16 May 1974).

The resistance of stainless steels to depassivation in concentrated chloride and acid media was studied. The depassivation pH value characterizing the resistance was measured. This value can be accurately determined using a rapid and reliable electrochemical method. The depassivation pH is the characteristic quality criterion for the crevice corrosion resistance of stainless steels. (FR)

14807 COMPARATIVE STUDY OF STRESS CORROSION TESTS FOR AUSTENITIC, AUSTENO-FERRITIC AND FERRITIC FE-Cr- Ni AND Fe-Cr ALLOYS IN CHLORIDE MEDIA. Influence of Steel Composition and Structure. Influence of the Chemical Properties of the Corrosive Medium. Comparison With the Results Found in Industrial Practice. Combrade, P.; Desestret, A.; McCright, R. D.; Gres, C. (Societe Creusot–Loire, 42-Unieux (France)); Gauthey, F. (Dijon Univ., 21 (France). Lab. de Recherches sur la Reactivite des Solides). Mem. Sci. Rev. Metall.; 71: No. 12, 807-822(Dec 1974). (In French).

From 13th meeting on alloy steels; Saint-Etienne, France (16 May 1974).

Corrosion tests were carried out in various chloride solutions ($MgCl_2$, LiCl, $CaCl_2$, NaCl) at temperatures between 100 and 200°C for concentrations from 100 ppM to 60% and in seawater containing 0.03 and 0.6 ppM oxygen. The results obtained are discussed. The ferritic and austeno-ferritic steels show a high resistance. (FR)

14808 QUANTITATIVE ANALYSIS OF HYDROGEN EMBRITTLEMENT. Van Leeuwen, H.-P. (National Lucht - en Ruimtevaart Laboratorium, Amsterdam (Netherland)). Mem. Sci. Rev. Metall.; 71: No. 9, 509-525(Sep 1974). (In French).

The effect of a mechanical stress on hydrogen diffusion is studied. The accumulation of hydrogen at the notch bottom or beneath a crack was calculated and the ratio between hydrogen critical concentration and local stresses was determined. The theory was applied to stress corrosion and a relation was established between the propagation speed of cracks and the intensity of stresses. The four fundamental mechanisms of hydrogen embrittlement are discussed. (FR)

14809 THE INFLUENCE OF THE INTERMETALLIC ZrV_2 PHASE ON THE OXIDATION AND CORROSION BEHAVIOR OF ZIRCONIUM VANADIUM ALLOYS. Borchers, H.; Tensi, H. M.; Maerz, G. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Metallurgie und Metallkunde). Werkst. Korros.; 25: No. 11, 816-821(Nov 1974). (In German).

7 figs.; 2 tabs.; 15 refs.

The good oxidation resistance of Zr and some of its alloys is due to the formation of an oxide layer characterized by good adhesion. Since, however, cracks are formed in such a layer upon prolonged oxidation the corrosion rate can be rather high in the later stages. An improvement of the properties of the oxide layer may be obtained by providing for the incorporation into the scale of atoms able to prevent oxygen diffusion. In the case of vanadium, however, no protective effect is obtained and the corrosion rate even increases as the V content is increased. This phenomenon is due to the poor solubility of V in the Zr so that the incorporation of V in the scale is inhibited during the initial stages of corrosion. The corrosion mechanism is the same in saturated vapor and NaCl solution. There are ZrV_2 particles which are not attacked and are embedded in a largely destroyed Zr matrix. The nobler ZrV_2 phase causes an anodic dissolution of the α-Zr phase. The avoidance of noble two-phase precipitations is a fundamental prerequisite to favorable oxidation behavior of Zr alloys. (GE)

Preparation and Fabrication

Refer also to abstracts 15762, 16386, 16479, and 16635.

14810 (AECL-4923) HIGH TEMPERATURE ROLLING OF Zr_3Al-BASED ALLOYS. Wilkins, B. J. S.; Reich, A. R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Apr 1975. 25p. Dep. NTIS (US Sales Only) $4.25. AECL $1.00.

Zr–Al (8 to 8.9 wt % Al) alloys of various impurity content have been hot rolled in the as-cast and in the transformed condition (890°C for 24 h). Results indicated that as-cast material has sufficient ductility to allow hot working operations such as tube extrusion at ≥ 1000°C. In the range 750 to 975°C, transformed material does not have sufficient ductility for this purpose. However, enough ductility exists at ≤ 750°C for transformed material to permit working operations such as tube sizing and straightening. The level of impurities present has a significant influence on hot rolling ductility of transformed material. (auth)

14811 (TID/SNM-61) ARMCO 22-13-5: DEVELOPMENT OF STANDARD PRACTICES FOR 17 1/2" OCTAGON. (Armco Steel Corp., Baltimore, Md. (USA). Advanced Materials Div.). 27 Dec 1971. 14p. Dep. NTIS $4.00.

For Aerojet-General Corp., Sacramento, CA.

Aerojet General has a requirement to produce a rocket nozzle from three heats of a commercially available material which would be suitable for nuclear environments. Their research work pointed toward Armco 22-13-5 which is a commercially available grade of stainless steel. After vacuum arc remelting was unsuccessful, satisfactory 17.5" octagons were produced using electroslag remelted material. These have been tested, approved and shipped to Wyman Gordon for forging. A standard practice for each step of the manufacture has been established and will be used for subsequent orders. The original request for vacuum remelted material was modified at Armco's request due to the problems associated with vacuum melting alloys containing volatile elements (N and Mn). The use of an arc furnace product was also precluded due to innate problems with ingot soundness even after forging to a 17 1/2" octagon. (auth)

14812 (UCRL-Trans-10876) PROCESS FOR MANUFACTURING PRESSED ARTICLES FROM POWDER. Coursen, D. L.; Noddin, G. A.; Reilly, J. I. 31 Mar 1966. Translation of German Patent No. 1,213,708. 21p. Dep. NTIS $4.25.

The process uses the force of an explosive detonated by ignition as the pressure. The process can be used to compact heat-resistant metals, such as Ti and Nb, and other materials. Examples of the process are given in which Ti, Fe, and W are compacted. (DLC)

14813 (WAPD-T-2599) PHYSICIST IN THE WORLD OF WELDING. Glickstein, S. S. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Dec 1974. 77p. (CONF-741209-3). Dep. NTIS $7.00.

From general meeting of the American Physical Society; Atlanta, Georgia, USA (5 Dec 1974).

Physics aspects of welding are reviewed. Information and discussions are included on history of welding, welding processes, variations in properties of material lots, welding arc control, cooling rates, hot cracking, weld pool phenomena, and welding arc phenomena. (JRD)

14814 BERYLLIUM COPPER CASTING UPDATED. Mast, H. S. Foundry Manage. Technol.; 102: No. 7, 84-86; 92(Jul 1974).

High Be (1.70 to 2.70 nominal) and low Be (0.10 to 0.60 nominal) Cu alloy castings have graduated to varied industrial applications and are now used extensively to make complex tooling for plastic products such as furniture. The high-Be alloys have high strength, low pouring temperature and high fluidity. They are used for tooling, bearings, gears and safety tools. The low-Be alloys have lesser strength but double the electrical and thermal conductivity. They are used for electronic components, electric switch gear parts, and welding industry parts. The use of high-Be Cu castings for plastic molds is due to its property of heat treating to hardnesses of RC 46 and its ability to cast interior cooling passages and pattern definition into the molds. Ceramic mold casting is now the fastest growing method of casting Be–Cu in the U.S. Berylliosis, a chronic lung disorder, can result from inhalation of small Be particles. The existing Be–Cu foundry industry's successful experience in making adjustments to both OSHA and EPA regulations is persuasive evidence that compliance is practical. (Metals Abstr.)

14815 SIMPLE AND EFFICIENT METHOD FOR PREPARING THIN FOILS FROM 500 μm TUNGSTEN WIRE. Fleet, D. E.; Ralph, B. (Cambridge Univ., Eng.). J. Less-Common Met.; 41: No. 1, 141-148(Jun 1975).

A method for the preparation of thin foils from single tungsten wires of 500 μm dia for examination by transmission electron microscopy is described. The technique is relatively easy, utilizes only readily-available equipment, and is very economical in specimen material. Typical micrographs are shown to illustrate the success of the method and the nature of the investigation for which it was evolved. (auth)

14816 PRODUCTION OF TANTALUM METAL BY THE ALUMINOTHERMIC REDUCTION OF TANTALUM PENTOXIDE. Nair, K. U.; Mukherjee, T. K.; Gupta, C. K. (Bhabha Atomic Research Center, Trombay, India). J. Less-Common Met.; 41: No. 1, 87-95(Jun 1975).

The results of an investigation into the preparation of massive tantalum by the open-aluminothermic reduction of tantalum pentoxide, and the purification of the aluminothermic tantalum by electron-beam melting and molten-salt electrorefining processes, are presented. Well-consolidated tantalum, corresponding to a recovery of 90%, has been obtained on a 500 g scale using oxide reduction by aluminium in an amount 50% in excess of the stoichiometric in the presence of 30 wt.% of potassium chlorate and 20 wt% of lime. The reduced metal has been purified by electron-beam melting. A fused-salt electrorefining route, employing an $NaCl-KCl-K_2TaF_7$ electrolyte operated under an inert atmosphere, has also been demonstrated as a possible alternative for the conversion of the aluminothermic tantalum to a higher purity. With the electrolyte containing 25 wt% of K_2TaF_7, a cathode current density of 60 A/ft^2, and a temperature of 800°C, a metal recovery of 84%, with an average current efficiency of 95%, has been achieved. (auth)

14817 CVD STUDY OF THE TUNGSTEN–SILICON SYSTEM. Lo, J. S.; Haskell, R. W.; Byrne, J. G.; Sosin, A. (Univ. of Utah, Salt Lake City). pp 74-90 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Tungsten, W_5Si_3, WSi_2, and Si were obtained from silane (SiH_4) and tungsten hexafluoride (WF_6) co-deposition by varying the ratio of the two flow rates at the substrate temperatures 600 and 800°C. Tungsten and silicon were co-deposited at 260°C, at a temperature too low for the individual elements to be deposited on a graphite substrate by simple decomposition of silane or hydrogen reduction of WF_6. The rate of WSi_2 co-deposition coating is 20 to 37 times faster than the conventional solid state diffusion at 855°C. Lattice parameter, phase morphologies, "deposition phase diagrams", and the compositions of the deposits were investigated. One atomic percent of silicon will break up the columnar grains of tungsten deposited at 600 and 800°C. (auth)

14818 EQUILIBRIUM CHEMISTRY OF BORON DEPOSITION. Walsh, P. N. (Union Carbide Corp., Indianapolis). pp 135-143 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Machine calculations of the equilibrium chemistry of the $H_2/BCl_3/Ar$ system were used to calculate the degree of conversion of BCl_3 to solid B, at several temperatures and one atmosphere total pressure, for constant BCl_3 partial pressure and for constant H_2/BCl_3 ratio. Combined equilibrium and mass transport calculations were used to deduce diffusion-limited reaction rates for experimental conditions employed in the kinetics study of Carlton, et al. (Second International Vapor Deposition Conference); this analysis confirms that the previous work did measure surface kinetics. Equilibrium calculations for the $H_2/BCl_3/Cr$ system indicate that $CrCl_2$ volatility may be too high for this to be a practical method of forming chromium boride coatings. (auth)

14819 DEPOSITION OF METAL FILMS BY LASER-CONTROLLED CVD. Berg, R. S.; Mattox, D. M. (Sandia Labs., Albuquerque, NM). pp 196-204 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

It is shown that a focused laser beam can be used to create local heating sufficient to cause tungsten deposition from the tungsten hexafluoride-hydrogen reaction. Using this technique, tungsten film patterns have been generated. Film resistivities are shown to depend on the linear power density. Problems and limitations of this method of film deposition are discussed. (auth)

14820 CHEMICAL VAPOR DEPOSITION OF TUNGSTEN FOR SEMICONDUCTOR METALLIZATION. Melliar-Smith, C. M.; Adams, A. C.; Kaiser, R. H.; Kushner, R. A. (Bell Labs., Murray Hill, NJ). pp 245-246 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Properties of CVD tungsten films produced by H_2 reduction of the hexafluoride or hexachloride, were investigated for suitability for use as Si integrated circuit metallizations. Adhesion orientation, stress, and electric properties were measured. Excellent, low-resistance ohmic contacts were made to highly doped Si. The MOS characteristics of $W/SiO_2/Si$ structures were measured; they were nearly ideal when the hexachloride was used (MOS dots from the hexafluoride were usually shorted or leaky). (DLC)

14821 COMPARISON OF MODELS ADVANCED TO EXPLAIN THE KINETICS OF TUNGSTEN HEXAFLUORIDE REDUCTION. Brecher, L. E. (Westinghouse Research Labs., Pittsburgh). pp 340-360 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Using data obtained by Holman and Huegel, Haskell, and later Cheung, have proposed models to predict the tungsten deposition rates observed in the $WF_6–H_2$ system. Similarly, Brecher has proposed a model based upon rate data collected by Berkeley, Brenner, and Reid. Testing of all three models against both data sets reveals that no model as originally proposed is wholly adequate to explain all of the data collected on this system. Each, with some modification in the rate constants, provides a good qualitative description of all of the data. It is concluded that any model used consistently will provide reasonably accurate rate predictions. (9 figures, 3 tables) (auth)

14822 DIFFUSION AS THE RATE CONTROLLING STEP IN THE REACTION OF TUNGSTEN HEXAFLUORIDE WITH TUNGSTEN AND THE ROLE OF TUNGSTEN PENTAFLUORIDE. McCarty, L. V.; Reith, W. E.; Simon, M. T. (General Electric Co., Cleveland). pp 361-362 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

The reactions are believed to be: 5 $WF_6(g) + W(s)$ reversible 6 WF_5 (g) and WF_5 (g) reversible $W(s) + 5F$ (g). In inert gases, the etching rate should go to zero at 2667°K when the partial pressure of F atoms becomes equal to that of WF_5. Experimentally, the etching rate decreases above 2250°K and goes to zero for 0.0127 atm WF_6 at 2630 to 2670°K. The etching reaction is described by

a model in which diffusion of WF_6 to the filament surface controls the rate of the reaction. (DLC)

14823 INFLUENCE OF GAS PRESSURE, GAS FLOW, AND SAMPLE TEMPERATURE ON THE CRYSTALLOGRAPHIC ORIENTATION OF CVD CHLORIDE TUNGSTEN. Wahl, G.; Batzies, P. (Brown, Boveri and Cie, AG, Heidelberg). pp 363-374 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ: Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

The CVD-chloride-method (x/2 Cl_2 + W yields WCl/sub x/ at 970°C; WCl/sub x/ + x/2 H_2 yields W + xHCl above 900°C) allows the deposition of tungsten layers with 100/111/110-preferential orientations. The produced orientation depends on gas composition, pressure, temperature, and gas flow. The influence of these parameters, especially that of the gas flow, on the orientation in the case of vertical flow, on to a horizontal plate is investigated. It is found that by varying only the gas flow it is possible to produce different orientations. The conditions are given at which the 100/111/110-orientations can be produced. The dependence of the W-deposition rate on the deposition parameters is measured and discussed. The measurements are compared with thermodynamic calculations. (9 figures) (auth)

14824 HIGH PERFORMANCE EMITTER FOR THERMIONIC DIODE OBTAINED BY CHEMICAL VAPOR DEPOSITION. Faron, R. (Societe des Usines Chimiques, Pierrelatte, France); Bargues, M.; Durand, J. P.; Gillardeau, J. pp 375-381 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Vapor deposition process conditions presently known for tungsten and molybdenum (specifically the range of high temperatures and low pressures) permit the achievement of high performance thermionic emitters when used with an appropriate technology. One example of this uses the following series of successive vapor deposits, the five last vapor deposits constituting the fabrication of the emitting layer: Mo deposit for the formation of the nuclear fuel mechanical support; Mo deposit, which constitutes the sheath of the nuclear fuel; epitaxed Mo–W alloy deposit; epitaxed tungsten deposit; fine-grained tungsten deposit; and tungsten deposit with surface orientation according to plane (110)W. In accordance with vapor deposition techniques previously developed, such a sequence of deposits can easily be achieved with the same equipment, even without having to take out the part during the course of the process. (auth)

14825 CHEMICAL VAPOR DEPOSITION OF TUNGSTEN FROM HYDROGEN REDUCTION OF WCl_6 WITH DOPANTS. Part I. Deposition in Static Reactors and Dopants Studies. Yang, W. C.; Brecher, L. E.; Cleary, J. G. (Westinghouse Electric Corp., Pittsburgh). pp 382-403 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Pure and doped tungsten depositions by hydrogen reduction of tungsten hexachloride were carried out in two reactors with 12-in. and 24-in. effective deposition lengths at operating pressures of 10 torr and 760 torr. The dopants evaluated were potassium, aluminum, and silicon. The data obtained for pure tungsten deposition were successfully correlated by assuming gas phase diffusion of reactants controls. Dopants were also successfully codeposited with the pure tungsten at levels up to 1000 ppM in the deposits. A supplemental thermodynamic study utilizing the principle of total free energy minimization confirmed the existence of stable chloride complexes as the principal doping compounds. Without addition of water, potassium was most likely codeposited as potassium chloride. With injection of water, the doping levels in the deposits were reduced substantially due to gas phase reactions. (auth)

14826 CHEMICAL VAPOR DEPOSITION OF TUNGSTEN FROM HYDROGEN REDUCTION OF WCl_6 WITH DOPANTS. Part II. Continuous Operation at Atmospheric Pressure. Yang, W. C.; Elikan, L.; Archer, D. H. (Westinghouse Electric Corp., Pittsburgh). pp 404-424 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Chemical vapor deposition from hydrogen reduction of WCl_6 in a continuous deposition reactor is described. Both pure tungsten deposition and codeposition with potassium, aluminum, and silicon on a substrate of 25-mil continuous tungsten wire were performed. The rate of deposition for doped tungsten was found to be much slower compared to that of pure tungsten. The rate of tungsten deposition decreased with increases in the H_2/WCl_6 ratio at constant temperature and decreased with increases in temperature above approximately 850°C at constant H_2/WCl_6 ratio due to gas phase reduction of WCl_6 to tungsten powder. Chlorine concentrations up to 60 ppM were also found present in the deposits. Increasing the substrate temperature and the H_2/WCl_6 ratio decreased the chlorine content. Unfortunately, the same scheme promoted gas phase reduction. In order to produce an adherent and non-slivering tungsten wire, every step of the operation--cleaning, deposition, and drawing--has to be carefully controlled. (auth)

14827 CHEMICAL VAPOR DEPOSITION OF FLUORIDE TUNGSTEN-MEASUREMENTS AND THERMODYNAMIC CALCULATIONS. Wahl, G.; Batzies, P. (Brown, Boveri and Cie, AG, Heidelberg). pp 425-438 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Gas flow and deposition geometry influence the growth (WF_6 + $3H_2$ yields W + 6 HF) of the CVD-fluoride tungsten layers. A special deposition geometry is investigated: The reaction gas stream is blown vertically through a nozzle (diameter 6.5 mm phi) on to a Mo-plate (20 mm phi). The distance between the nozzle and plate was a equals 15 mm. The influence of pressure (3 to 760 torr) and temperature (300–1500°C) at constant mass flow (l/sub WF_6/ equals 5 l/h, l/sub H_2/ equals 25 l/h) on the structure of the layer under defined flow conditions is investigated. Results are compared with thermodynamic calculations and with heat transfer data. (14 figures) (auth)

14828 BONDED CVD TANTALUM COATINGS ON STEEL SUBSTRATES. Glaski, F. A. (Fansteel Special Structures, Torrance, CA). pp 521-533 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Data are reviewed for tantalum as a widely applicable corrosion-resistant metal. CVD is presented as an attractive method for applying tantalum to steel hardware surfaces to protect them from corrosive environments. A research study is traced wherein it is concluded that the bond between CVD tantalum and various steel substrates degrades with increasing carbon content in the steel. Before applying CVD tantalum or niobium, therefore, the driving force for carbon diffusion from steel to tantalum is eliminated first by forming a thin carbide barrier on the steel surface which is more thermodynamically stable than tantalum carbide. Various barriers are discussed. Diffusion/displacement reactions between group IV-b metal halides and steel are emphasized. Representative corrosion, metallographic and microprobe data are presented for titanized bonded, tantalum-coated steel. Types and sizes of hardware are considered which can be accommodated by current and projected future CVD tantalum technology. Economic analysis places the cost of CVD tantalum-coated hardware at approximately twice that of glassed steel hardware. (auth)

14829 CVD OF BORON. Hintermann, H. E.; Bonetti, R.; Breiter, H. (Laboratoire Suisse de Recherches Horlogeres, Neuchatel). pp 536-545 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

The deposition of boron on fine wires by the gas-phase reduction of its halides was studied with the aim of producing instrument and jewel bearings. The deposits are hard ($HV_{0.05}$ equals 3400 kp/mm^2) and display good lubricant-free frictional behavior against titanium carbide. Deposits of 1.5 mm rod diameter were formed. Radial cracks caused by reaction with the substrate, and the different coefficients of thermal expansion, were observed. Prior deposition of boron nitride reduces diffusion of boron into the substrate, but complete elimination of all internal tensions has not been achieved as yet. (auth)

14830 SINGLE-CRYSTAL GROWTH OF In_2Bi AND In_3Bi_5 COMPOUNDS. Cruceanu, E.; Miu, L.; Invanciu, O. (Comitetul de Stat pentru Energia Nucleara, Bucharest (Romania)). J. Cryst. Growth; 28: No. 1, 13-15(Jan 1975).

A method for the crystal growth of In_3Bi_5 and In_2Bi compounds, based on revised equilibrium phase diagram of the In-Bi system, is reported. Some transport properties of the obtained crystals are also presented. (auth)

14831 ELECTRON BEAM MELTING AND CASTING PROCESSES FOR FABRICATION OF SEMI-FINISHED MATERIAL MADE OF REACTIVE METALS. Stephan, H. (Leybold-Heraeus G.m.b.H. und Co. K. G., Hanau (F. R. Germany)). Metall; 28: No. 10, 959-968(Oct 1974). (In German).

22 figs.; 1 tab.

An attempt is made to explain the possibility of using three novel electron beam melting and casting techniques as direct manufacturing methods for semifinished and final products of high quality, with the broadest charge of scrap and raw material, at a minimum of investment, working costs and material. It is obvious that the electron beam melting and casting technology will occupy and maintain a firm place in the fine steel and special metal industry. (GE)

14832 STABILISATION OF RESIDUAL FERROUS CHLORIDES BY PRODUCTION OF STAINLESS STEEL PARTS USING POWDER METALLURGY. Schweiger, D.; Lacour, A.; Accary, A. (Clermont-Ferrand Univ., 63 (France)); Francois, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). Mem. Sci. Rev. Metall.; 71: No. 12, 833-840 (Dec 1974). (In French).

From 13th meeting on alloy steels; Saint-Etienne, France (16 May 1974).

Ultrafine sinterable stainless-steel powder is produced by atomization of an aqueous solution of iron, chromium, and nickel chlorides and reduction by hydrogen of the chloride powder obtained. The process involves the atomization in air and the reduction by high purity hydrogen at 1000°C (700m^3H_2/kg of chloride). The reduction time is about 10 hours. (FR)

14833 TITANIUM ALLOY. Glazunov, S. G.; Solonina, O. P.; Ulyakova, N. M.; Kuraeva, V. P.; Lyapicheva, N. F.; Nikishov, O. A. French Patent 2,213,986/A/. 18 Jan 1973. 8p. (In French).

The alloy which is the subject of the invention is of the type consisting of Al, Zr, Sn, Mo, W, Si, and Cr and is characterized by the fact that it also contains Re. The composition of the alloy is 6.0 to 7.5% Al, 0.5 to 2.0% Zr, 0.5 to 2.0% Sn, 1.5 to 2.7% Mo, 0.2 to 1.2% W, 0.1 to 0.35% Si, 0.2 to 0.5% Cr, 0.05 to 0.1% Re, with the rest of the alloy being Ti. This alloy is used to fabricate pieces working at high temperatures. (FR)

14834 PREPARATION OF SELF-SUPPORTING SINGLE-CRYSTAL C.V.D. TUNGSTEN FILMS. Srinivasan, S.; Reichelt, K.; Wenzl, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Nucl. Instrum. Methods; 125: No. 4, 599-600(1 May 1975).

The deposition of single-crystal tungsten films on molybdenum single-crystal substrate by chemical vapor deposition is described and the conditions are given. After the deposition, a hole is etched in the substrate to form a self-supporting single-crystal film of tungsten. The perfection and structure of this film is studied by x-ray methods. (auth)

14835 ELECTROLYTIC MAGNETIC Co-BASE ALLOYS. Mechanism of electrodeposition of Some Bicomponent Coatings. Rachinskas, V. S.; Matulis, Yu. Yu. (Inst. of Chemistry and Chemical Technology, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 6: No. 85, 15-23(1974). (In Russian).

It has been established that the amount of Mn, Mo, P, and V increases in the gel along with the increase of the concentration of Mn^{2+}, MoO_4^{2-}, $H_2PO_2^-$, and VO_3^- in the electrolytes. Concentration of Mo, P, and V decreases but Mn c increases with alkalinity of electrolyte. There is a correlation between the chemical composition of Co-Mn, Co-Mo, Co-P, and Co-V alloys and chemical composition of gels, obtained in adequate electrolytes under various conditions. Magnetic properties of electroreduced gel are analogous to those of electroplated alloys. On the basis of experimental data it is concluded that electrodeposition of Mn, Mo, P, and V together with Co, and P together with Ni goes through the colloidal phase of basic compounds of the codeposited metals and the physical-chemical properties of coating. (auth)

14836 ELECTROLYTIC MAGNETIC Co-BASE ALLOYS. New Theory of Metal Co-Deposition Process. Rachinskas, V. A.; Matulis, Yu. Yu. (Inst. of Chemistry and Chemical Technology, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 6: No. 85, 25-36(1974). (In Russian).

Chemical composition and the electrolytic reduction process of gel obtained from Co-W electrolytes containing $NH_4H_2PO_2$ and $NaVO_3$ as a function of electrolyte composition and the degree of alkalinity was investigated. It was found that the W amount in Co-W-P, Co-W-Mn, and Co-W-V increases along with growth of WO_4^{2-}, VO_3^- and the fall of $H_2PO_2^-$, Mn^{2+} concentration (c) in respective electrolytes. It also increases with the decrease of alkalinity degree. Amount of P and V in Co-W-P and Co-W-V gels increases with the increase of $H_2PO_2^-$ and VO_3^- c correspondingly and with the decrease of alkalinity degree. Amount of Mn in gels increases when Mn^{2+} and increases and Co^{2+} c in electrolytes decreases, as well as when the alkalinity degree of solutions is increasing. It was established that gels of basic compounds Co-W-P, Co-W-Mn, and Co-W-V can be electroreduced forming respective magnetic metal alloys. There is correlation between the chemical composition of Co-W-P, Co-W-Mn, and Co-W-V alloys and gels, obtained from the same electrolytes at various conditions. A new theory of alloy electrodeposition mechanism was developed. It states that the formation of alloys occurs through the colloidal phase of basic compounds of the co-deposited metals. The electrodeposition is followed by a definite intensity of H^+ discharge. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 14962, 15764, 16240, 16242, 16261, 16281, 16290, 16435, 16545, and 16564.

14837 (AWRE-O-17/75) EARLY STAGES IN THE AGEING OF A QUENCHED URANIUM-2 W/O MOLYBDENUM ALLOY. Smith, C. J. E.; Jones, A. D.; Ruckman, J. C. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). May 1975. 33p. Dep. NTIS (US Sales Only) $4.75. UK pounds 1.00.

The ageing behavior of a uranium-2 wt % molybdenum alloy quenched from 1223°K into ice/water mixture to produce the α'U martensitic structure was studied using optical and transmission electron microscopy and x-ray diffraction techniques. It is proposed that the first stages in the ageing sequence involve the formation of precipitates of α'U rich in molybdenum which subsequently transform to the γU phase. (14 figures) (auth)

14838 (EUR-5229e) CATALOGUE OF REFERENCE MATERIALS OF INTEREST TO NUCLEAR ENERGY. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). 1974. 36p. Dep. NTIS (US Sales Only) $5.00. EUR B. Fr. 70,-.

A provisional list of available chemical, isotopic, and trace elements reference materials of interest to nuclear energy has been established. Emphasis is given to the substances containing uranium and plutonium. Certified values, sample sizes, prices, and addresses of suppliers are indicated. (auth)

14839 (FRNC-TH-508) INVESTIGATION OF THE MAGNETIC BEHAVIOR OF IRON-NICKEL ALLOYS OF THE INVAR TYPE. Billard, L. (Grenoble-1 Univ., 38 (France)). 1974. 114p. (In French). INIS.

A cell model is presented for invar type iron-nickel alloys (nickel concentration around 35%) which allows a satisfactory interpretation of Moessbauer spectra. The alloy is divided up into cells containing about eighteen atoms. To each cell is assigned a paramagnetic or ferromagnetic behavior according to whether the cell contains less or more than 29% nickel, and an inter-cell coupling term due to nonhomogeneity of magnetization is introduced. The distribution of the internal fields observed by Moessbauer effect coincides with the diagram by ferromagnetic zones (strong) on the one hand and polarized paramagnetic zones on the other. To explain the temperature-dependence of the magnetization curves, an intuitive model related to the cell model is introduced. From the quantitative point of view, this implies the introduction of a constant adjustable for each concentration which expresses the effect of atomic interactions. The model is digitalized by the use of the rigid band approximation with renormalization of the interatomic exchange parameter. (FR)

14840 (IC-74-49) ELECTRON INTERACTION AND INSTABILITIES IN ONE-DIMENSIONAL METALS. Ramakrishnan, T. V. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1974. 10p. INIS.

The effect of electron-electron interaction V(x) in one-dimensional metals is investigated. Charge density wave (CDW) and Cooper pair (CP) instabilities tend to occur if the small separation ($x\ (2k_T)^{-1}$) repulsion V(x) is strongly reduced or is made attractive. It is shown that there is a large induced CP attraction due to exchange of virtual CD fluctuations near, but above, the CDW instability temperature T_{CDW}. (INIS)

14841 (IC-74-88) MAGNETIZATION IN METALLIC FILMS. Pant, M. M.; Das, M. P. (Indian Inst. of Tech., Kharagpur. Dept. of Physics). Sep 1974. 12p. INIS.

A semi-infinte magnetic electron gas is discussed and it is found that the boundedness has a tendency to favor the occurrence of ferromagnetism. This result is used for obtaining the critical temperature and magnetization dependence of thickness for magnetic films. (INIS)

14842 (LA-5962-MS) PROCESS FOR IMPROVING THE LOW TEMPERATURE DUCTILITY OF TUNGSTEN-BASE COMPOSITES. Zukas, E. G. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-ENG-36. 14p. Dep. NTIS $4.00.

At temperatures below about 100°C, liquid-phase-sintered tungsten-base composites fail in a brittle manner because of the formation of cleavage cracks in the tungsten spheroids. Improving the ductility, then, would require some alloying addition or treatment which would improve the ductility of these spheroids, or some method of changing the stress distribution, such as putting the surface in compression, which would reduce stress concentrations and thereby require a higher load to initiate fracture. The ductilizing process used here consists of coating the composite with a ductile metal followed by heat treating at a high enough temperature to insure sufficient diffusion so that the coat and base become integral. The ductile coat is now the 'piece' surface, and the initiation of cleavage cracks requires much greater stresses. Coats of copper, nickel, gold, and cobalt have been used successfully. A possible added advantage is that the surface properties can now be controlled if certain reflective properties or corrosion resistance are needed. Also soldering or low temperature brazing operations are feasible, allowing the construction or assembly of intricate shapes which could not be accomplished previously. (auth)

14843 (ORNL-TM-4928) MATHEMATICAL DESCRIPTION FOR THE STRESS-STRAIN BEHAVIOR OF ANNEALED 2¼ Cr-1 Mo STEEL. Klueh, R. L.; Hebble, T. L. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 22p. AT.

A detailed series of tensile tests were conducted on one heat of annealed 2¼ Cr–1 Mo steel over the range 25 to 593°C and nominal strain rates of 0.4, 0.04, 0.004, and 0.0004/min. In order to determine an empirical relationship to represent the flow behavior, the true-stress true-strain data from these tests were fitted to several proposed models. The models fit were those proposed by Hollomon, Ludwik, Ludwigson, and Voce. From a comparison of the standard error of estimate, the Voce equation was concluded to be the best mathematical description of the data under most test conditions and the best single representation over the wide range of test conditions. (10 fig, 7 tables) (auth)

14844 (RD/B/N-3029) EFFECT OF TEMPERATURE ON CREEP CRACK PROPAGATION IN AISI TYPE 316 STAINLESS STEEL. Nicholson, R. D. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

Creep crack growth rates have been measured in double edge notched specimens of solution treated AISI Type 316 stainless steel at temperatures of 600, 700, 740, 800, and 850°C. It is found that the crack growth rates da/dt, at each temperature can be described by the equation: $da/dt = N\sigma_{Nett}^{p}$, where N and p are constants for a particular temperature and σ_{Nett} is the nett section stress. The stress exponent, n, in the equation $\dot{\epsilon} = A\sigma^n$ is found to be equal to p at each temperature and the nett section stress criterion and a displacement-based criterion are shown to be compatible. Apparent activation energies for creep and creep crack growth have been measured in the temperature range 740 to 850°C and over limited ranges of stress and temperature comparable energy values are found. These results suggest that a creep mechanism involving dislocation climb could be rate controlling in the crack propagation process. The results are explained by considering the stress redistribution that takes place at the crack tip and the resulting strains in the specimen, indicating that creep crack growth is governed by ligament and ultimately by crack tip displacements. (auth)

14845 (RDT-M-2-3T(5-75)) CARBON AND ALLOY STEEL WELDING FITTINGS (ASME SA-234 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). May 1975. 13p. RSO.

A standard prescribing requirements for carbon and alloy steel welding fittings (ASME SA-234 with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M 2-3T, dated January 1973. (JRD)

14846 (SLL-74-5215) FRACTURE OF URANIUM ALLOYS. Saxton, H. J. (Sandia Labs., Livermore, Calif. (USA)). Mar 1974. Contract AT(29-1) 789. 68p. (CONF-740205-14; RS-8232-2/41672). Dep. NTIS $6.50.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

Since the fracture of uranium and its alloys has received little emphasis in the open literature, the first objective of this paper is to review past and current research in this area. Fracture toughness (K/sub Ic/) values for uranium alloys are compared to those for frequently used structural materials, with emphasis placed on work relating fracture behavior to microstructure and tensile behavior. Recent investigations concerned with the prediction of K/sub Ic/ and the development of simple but reliable fracture toughness test methods are discussed. The second objective of the paper is to describe an investigation of the fracture behavior of U–3/4 Ti and U–2 1/4 Nb. The research pursued two goals: 1) Characterizing the alloys' fracture toughness in a variety of service environments: The effects of strain rate, temperature, and humidity upon the fracture toughness of U–3/4 Ti and U–2 1/4 Nb were measured. 2) Relating fracture toughness to microstructural conditions: The fracture toughness of U–2 1/4 Nb significantly improved through careful heat treating. This improvement is related to microstructural changes produced in the alloy and correlated to changes in fracture mode. In addition, the effects of shear forming and hydrogen content upon the fracture behavior of U–3/4 Ti were investigated. (9 tables, 18 figures, 73 references) (auth)

14847 (TRG-REPORT-2686(S)) DEVELOPMENT OF FATIGUE CRACK PROPAGATION MODELS FOR ENGINEERING APPLICATIONS AT ELEVATED TEMPERATURES. Tomkins, B. (UKAEA Reactor Group, Springfields). May 1975. 27p. Dep. NTIS (US Sales Only) $4.50.

The value of modeling the fatigue crack propagation process is discussed and current models are examined in the light of increasing knowledge of crack tip deformation. Elevated temperature fatigue is examined in detail as an area in which models could contribute significantly to engineering design. A model is developed which examines the role of time-dependent creep cavitation on the failure process in an interactive creep-fatigue situation. (auth)

14848 (Y-1987) EFFECT OF NICKEL PLATING UPON TENSILE TESTS OF URANIUM-0.75 TITANIUM ALLOY. Hemperly, V. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 27 Jun 1975. Contract W-7404-eng-26. 9p. Dep. NTIS $4.00.

Electrolytic-nickel-plated specimens of uranium-0.75 wt percent titanium alloy were tested in air at 20 and 100 percent relative humidities. Tensile-test ductility values were lowered by a high humidity and also by nickel plating alone. Baking the nickel-plated specimens did not eliminate the ductility degradation. Embrittlement because of nickel plating was also evident in tensile tests at - 34°C. (auth)

14849 ELECTRONIC BAND STRUCTURE OF V_3Ga. Goldberg, I. B. (Hebrews Univ., Jerusalem). J. Phys., C (London); 8: No. 8, 1159-1180(21 Apr 1975).

A tight binding calculation of the band structure of V_3Ga is performed. The 3d band of the vanadium, and 4s and 4p bands of the galliums are considered. The energy levels, the density of states, and the wavefunctions are calculated. The energy levels at high-symmetry points are compared with those calculated previously by Mattheiss by the APW method; agreement to within 50 mRyd is found. The identification of levels according to the linear chain model suggested previously is found to be correct in most cases. The structure of a peak in the density of states function, due to the $\delta_2(m_l = \pm 2;\ d_{xy})$ band with $K_z \approx 0$, which has previously been identified with the peak proposed by Clogston and Jaccarino (Phys. Rev.; 121:1357 (1961)), is investigated in some detail. The Clogston–Jaccarino peak is found to be composed also of states belonging to the $\pi(m_l = \pm 1,\ d_{xz}, d_{yz})$ band, with $K_z \approx \pi/a$. From this work it appears that the coupled linear chain model for A-15 compounds is a rather good approximation. The question whether the σ $(m_l = 0, d_z^2)$ band has a planar Fermi surface is also investigated and found to depend critically upon the exact degree of hybridization with the Ga 4p band. (auth)

14850 EFFECT OF MICROPOROSITY ON THE RECRYSTALLIZATION AND CREEP BEHAVIOR OF TUNGSTEN WIRES. Horacsek, O.; Bartha, L. (Kozponti Fizikai Kutato Intezet, Budapest). High Temp.–High Pressures; 6: No. 4, 371-381 (1974).

From 8th Plansee seminar; Reutte, Austria (27 May 1974).

The retarded lateral grain growth in doped tungsten wires that is caused by the bubble rows can be directly observed by means of an emission microscope. Emission microscopy, carried out simultaneously with high-temperature creep deformation, showed that the rupture occurs for both the pure and the doped

tungsten wires because of the formation and growth of grain-boundary cavities, but the nature of the cavity nuclei in the two materials is different. In the doped material the cavities grow from the bubbles, while in the pure material the cavity nuclei are microcracks produced continuously during strain. It is suggested that cavities can also form in incandescent lamp filaments, contributing to the deterioration of the coils. (auth)

14851 DETERMINING THE OPTIMUM CONDITIONS FOR PRESSURE WORKING SUPERCONDUCTIVE NIOBIUM ALLOYS. Arsen'ev, O. B.; Okhrimenko, Ya. M. pp 165-171 of Struktura i Svoystva Sverkhprovodyashchikh Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

An investigation is made of the mechanical properties of Nb–Zr–Ti alloys at different temperatures; a diagram is plotted for processing recrystallization and the design is presented for cutoff backing blocks with taper junctions for deforming cylindrical ingots of difficulty deformable alloys under hammers with constant degree of deformation $\epsilon = 0.25$ and relative feed of 0.7 to 1.0. A temperature schedule is proposed for heat treatment. (Ref. ZH.)

14852 CONSTRUCTION AND TECHNOLOGICAL CHARACTERISTICS OF NIOBIUM WIRE FOR SUPERCONDUCTIVE COAXIAL RADIO-FREQUENCY CABLE. Khrenkov, N. N.; Gal'perovich, D. Ya. pp 171-176 of Struktura i Svoystva Sverkhprovodyashchikh Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

An investigation is made of the influence of the wire-making process on microwave surface resistance. Indices are established which are suitable for evaluating the rf-superconductive properties of niobium wire during manufacture. Methods are proposed for measuring the surface resistance and surface contamination. (Ref. Zh.)

14853 INFLUENCE OF PRESSURE ON THE SUPERCONDUCTIVE TRANSITION OF $Nb_{12}Al_3Ge$. Ageev, N. V.; Alekseevskii, N. E.; Shamray, V. F. pp 3-6 of Struktura i Svoystva Sverkhprovodyashchikh Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

An investigation was made of the influence of mechanical action on the superconducting transition and substructure of cast specimens of compound $Nb_{12}Al_3Ge$. Grinding, uniaxial compression under a load of 20 metric tons per square centimeter, and high pressure (60 and 100 kb) led to blurring of the transition curve and displacement toward lower temperatures. At the same time there is a reduction in the size of mosaic blocks, and stresses of the second kind arise. (Ref. Zh.)

14854 CRITICAL CURRENTS OF Ti–Nb–Ta–O ALLOYS. Bychkov, Yu. F.; Uzlov, V. Yu.; Rozanov, A. N.; Mitrofanskii, A. A. pp 123-130 of Struktura i Svoystva Sverkhprovodyashchikh Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

An investigation is made of the influence of substituting tantalum for part of the niobium in alloys with 40 and 50 wt% Ti and the influence of structural changes during annealing on the j_k of alloys in the Ti–Nb–Ta system in the region of concentrations corresponding to high H_k. The introduction of oxygen additives into the alloys and creation of an optimum structural state leads to an increase of j_k. (Ref. Zh.)

14855 ELECTRONIC STRUCTURE OF SUPERCONDUCTING METALS AND ALLOYS AND ITS RELATION TO OPTICAL PROPERTIES. Motulevich, G. P.; Golovashkin, A. I.; Shubin, A. A. pp 20-24 of Elektronnoe Stroenie Sverkhprovodiashchikh Metallov i Splavov i Sviaz' s Opticheskimi Svoistvami. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The possibility of using optical measurements to determine the electronic characteristics of superconducting metals is considered. It is shown that optical measurements carried out in a wide spectral range can be used to determine both the characteristics of conduction electrons and the characteristics of electrons participating in interband transitions. Electronic characteristics obtained by the optical method are presented for the metals niobium and vanadium and for the alloys Nb–Sn, Nb–Ti, and V–Ga. Correlations are obtained between the electronic characteristics and the superconducting parameters of these metals and alloys. (IAA)

14856 RELATION BETWEEN THE ENERGY OF VACANCY FORMATION AND THE THERMAL EXPANSION COEFFICIENT OF CRYSTALS. Bovenko, V. N. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 135-136(1975). (In Russian).

It is known that crystals melt when the relative increase in lattice constant attains a certain standard value $(\Delta a/a)_{max}$, where a is the lattice constant. The ratio of the energy of vacancy formation E_v and melting T_m is a constant: $E_v/T_m = \beta$ (a constant). For most metals the lattice deformation before melting is 0.20 to 0.25 or $(\Delta a/a)_{max} = \alpha T_m$. It is then found that $E_v\alpha = \beta(\Delta a/a)_{max}$ on eliminating T_m. Since $\beta(\Delta a/a)_{max}$ is a constant, then $E_v\alpha$ is also a constant. Values of the thermal expansion coefficient α and of the energy of vacancy formation are tabulated for 9 metals. For the low-melting metals with a bcc lattice (potassium, sodium, and lithium) the average value of the product $E_v\alpha$ was 21.3 eV/°. For the refractory metals with a bcc lattice (niobium, molybdenum, and tungsten) the value of $E_v\alpha$ was 22.5, and for typical metals with a fcc lattice (aluminum, silver, and copper) the average value of $E_v\alpha$ was 21.2 eV/°. The deviation in values of the product $E_v\alpha$ does not exceed 10%. (SJR)

14857 STUDY OF THE PROPERTIES OF SINGLE CRYSTALS OF GADOLINIUM–DYSPROSIUM ALLOYS. Levitin, R. Z.; Savitskii, E. M.; Terekhova, V. F.; Chistiakov, O. D.; Lakovenko, V. L. pp 100-107 of Issledovanie Svoistv Monokristallov Splavov Gadolinii–Disprozii. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The anisotropy of the magnetization and microhardness of gadolinium-dysprosium alloys was studied. A method of growing single crystals of gadolinium-dysprosium alloys is described which was successfully used to grow such crystals in a wide range of concentrations. It is established that the deviation of the dysprosium content along the length of single-crystal bars does not exceed 3 to 5% of the initial content. Measurements were made of the magnetic properties of the alloys along various crystallographic axes in the temperature range from 4.2 to 300°K in pulsed magnetic fields up to 280 kOe. The dependence of the coefficient of uniaxial magnetic anisotropy on the temperature and composition of the alloys was determined. It is noted that the microhardness of single crystals of the alloys on a basis plane is twice that on a prism plane. It is shown that the uniaxial magnetic anisotropy of dysprosium and gadolinium-dysprosium alloys is caused by an electrostatic interaction between multiplet moments of 4f-electrons of dysprosium and the crystalline lattice field. (IAA)

14858 SYNTHESIS AND MAGNETIC PROPERTIES OF SOLID SOLUTIONS OF RHENIUM DIOXIDE IN TITANIUM DIOXIDE. Brach, B. Ya.; Chezhina, N. V. J. Gen. Chem. USSR.; 44: No. 12, 2728-2729(Dec 1974).

Translated from Zh. Obshch. Khim.; 44: No. 12, 2778(Dec 1974).

β–ReO_2–TiO_2 solid solutions were prepared by roasting finely ground mixtures tightly packed in quartz ampules, first at 800° and then at 900°. Composition varied from 0.5 to 3 mole % ReO_2, and the systems were one phase and of the TiO_2 structure with a lattice parameter which conformed to Vegard's law. The paramagnetic component (P) of the magnetic susceptibility is typical for the dilution of antiferromagnetic substances. The effective magnetic moment varies with composition and at infinite dilution approaches the value of 3.5 μ_B, lower than the value (3.74 μ_B) calculated for the isolated Re atom in K_2ReCl_6. Calculations of P for random distribution of Re in TiO_2 lead to too high values. These results indicate the existence of strong bonds between Re atoms. (DLC)

14859 STUDY OF SIGMA-PHASE PRECIPITATION IN Mo-Re ALLOYS. Freze, N. I.; Levitskii, A. D.; Tyumentsev, A. N.; Korotaev, A. D. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 143-144(1975). (In Russian).

Electron microscopy of thin sections and replicas was used to follow sigma-phase decomposition in molybdenum alloys containing 52 to 56 wt % Re and 52 to 56 wt % Re with 0.05 to 0.10 wt % Fe. Intense precipitation of a finely-dispersed plastic sigma-phase in deformed samples is observed at temperatures of 1100°C and also at 900°C after aging for 50 hours. Nondeformed foils after annealing for 50 h at 900°C remain single-phase. This result indicates that the sigma phase nucleates exclusively on crystal structure defects such as grain boundaries, boundaries of twinned crystals and dislocations. Thus by changing the initial state and annealing temperature it is possible to modify substantially the dispersion and spacial distribution of the sigma phase. Low temperature decomposition with precipitation of a sigma phase can be used as a method for the dispersion strengthening of Mo–Re alloys. Unfortunately at T > 1100°C the finely-dispersed, sigma-phase precipitate coagulates readily so that the heat strength properties of such alloys are probably not high. (SJR)

14860 CHANGE IN FLOW STRESS OF BERYLLIUM AFTER STRESS RELIEF. Khristenko, I. N.; Papirov, I. I. (Physical-Technical Inst., Kazan). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 134-136(1975). (In Russian).

Results of a study are presented showing that in beryllium a decrease in flow stress after stress relief and repeated deformation takes place even at low test temperatures. This effect called mechanical relaxation is investigated on polycrystalline beryllium of high purity (>99.95%) in the temperature region from 77

to 570°K as a function of the degree of preliminary deformation and holding time in the unstressed state. The decrease in the stress required for the beginning of subsequent plastic flow is found to decrease with an increasing number of cycles by a factor of two after 7 cycles of testing. (SJR)

14861 DEFORMATION MODES IN $NbAl_3$. Shechtman, D.; Jacobson, L. A. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Metall. Trans.; 6A: No. 7, 1325-1328(Jul 1975).

The DO_{22} lattice of the $NbAl_3$ intermetallic compound shows very limited ductility at room temperature. The slip and twinning systems that are active during the deformation process were investigated. Evaluation of the possible deformation modes was performed and contrast analysis in the transmission electron microscope revealed both expected and unexpected deformation modes. Two types of dislocations were found in the deformed structure, namely the a (110) superdislocation on the (112) plane and loops of unidentified dislocations on the (010) plane. No evidence of (201) superdislocations was found, probably due to the fact that this type of dislocation is expected to move in groups of four. Twins of the (112) type were found to play an important role in the deformation process since they supply a component of shear perpendicular to the (001) plane. (auth)

14862 HIGH CREEP ACTIVATION ENERGIES FOR DISPERSION STRENGTHENED METALS. Lund, R. W.; Nix, W. D. (Stanford Univ., CA). Metall. Trans.; 6A: No. 7, 1329-1333(Jul 1975).

Creep studies on dispersion strengthened metals have often resulted in inexplicably high creep activation energies and high stress exponents. An analysis is presented which shows that the contribution of the temperature-dependent elastic modulus to the apparent activation energy can be very large. Two cases are examined in which the difference between the apparent activation energy and the activation energy of self diffusion is almost entirely accounted for by the contribution of the temperature dependent elastic modulus. The modulus correction is particularly important at high temperatures and for materials with high stress exponents. (auth)

14863 EFFECT OF NITROGEN ON THE STRENGTH OF THORIUM. Peterson, D. T.; McLachlan, D. R. (Iowa State Univ., Ames). Metall. Trans.; 6A: No. 7, 1359-1366(Jul 1975).

The effect of nitrogen in solid solution on the plastic deformation of polycrystalline thorium was studied by measuring the flow stress from 4.2 to 773°K at several strain rates. Nitrogen was found to behave similarly to carbon in thorium and increased the thermally activated component of the flow stress. The activation energy was 1.3 eV for overcoming nitrogen atoms in solution. Aging the higher nitrogen alloys produced an age hardening contribution to the flow stress which was a thermally activated component at about 600°K but became an athermal component at lower temperatures. (13 fig) (auth)

14864 FATIGUE CRACK GROWTH IN A TYPE 316 STAINLESS STEEL AND A 20 PCT Cr/25 PCT Ni/Nb STAINLESS STEEL AT ELEVATED TEMPERATURES. Wareing, J. (United Kingdom Atomic Energy Authority, Springsfields, Eng.). Metall. Trans.; 6A: No. 7, 1367-1377(Jul 1975).

Fatigue failure in metals and alloys occurs by the nucleation and controlled propagation of a surface crack. At ambient temperature, propagation is transgranular and is controlled, to a large extent, by continuum plasticity effects at the crack tip. At elevated temperatures, this simple process might be affected by oxidation and the tendency towards intergranular propagation. The elevated temperature fatigue crack propagation behavior of a 20/25/Nb stainless steel and a type 316 stainless steel is studied by optical measurement of the crack growth rate of artificially induced notches under conditions where gross plastic straining is present in the bulk of the material. Tests conducted at ambient temperature are included for comparison with elevated temperature behavior. By reference to fatigue life data for smooth unnotched specimens, tested under identical conditions to the crack growth tests, an attempt is made to rationalize the roles of crack initiation and propagation in the fatigue process and indicate the relevance of crack growth data in predicting fatigue life data. (auth)

14865 STRUCTURE-PROPERTY RELATIONSHIPS IN THERMOMECHANICALLY TREATED BERYLLIA DISPERSED NICKEL ALLOYS. Grewal, M. S. (Gillette Co., Boston); Sastri, S. A.; Grant, N. J. Metall. Trans.; 6A: No. 7, 1393-1404(Jul 1975).

BeO dispersed nickel alloys, produced by powder metallurgy techniques, were studied extensively in stress rupture at 815, 982, and 1093°C (1088, 1255, and 1366 K) and by transmission electron microscopy. The alloys were subjected to a variety of thermomechanical treatments (TMT) to determine the benefits of TMT on properties. It is shown that the use of intermediate annealing treatments after 10 percent reduction steps is highly beneficial on both low and high temperature properties. It is indicated that the high temperature strength is not primarily dependent on the grain aspect ratio or texture but depends strongly on the dislocation density and distribution of dislocations in a stable substructure which is pinned by the fine oxide dispersion. (22 fig) (auth)

14866 HYDROGEN PERFORMANCE OF PRECIPITATION-STRENGTHENED STAINLESS STEELS BASED ON A-286. Thompson, A. W. (Rockwell International, Thousand Oaks, CA); Brooks, J. A. Metall. Trans.; 6A: No. 7, 1431-1442(Jul 1975).

Eleven alloys similar to commercial A-286 but with small variations in chemistry were tested to assess whether the performance of this type of stainless steel, which shows a ductility (RA) loss of about 48 percent when hydrogen charged, could be improved. It was found that removal of Mn resulted in an RA loss of only 15 percent; low Mn plus a 5 percent increase in Ni gave further improvement to 11 percent RA loss. Reductions in C, Si and B had little effect on these RA losses. None of the above changes had significant effect on strength. Other chemistry changes were unsuccessful: additions of Al, Ti, Ti + Mo, or decreases in Ni, increased the ductility loss. Extensive examination of thin foils permitted a structural rationale for behavior in hydrogen in terms of the effects of second-phase particles on ductile fracture, particularly as affected by the misfit between the austenite and the gamma precipitates. This rationale was consistent with fractographic observations. (auth)

14867 ORIENTATION DEPENDENCE OF THE ENERGY OF SLIT CRACKS IN BCC REFRACTORY METALS. Yang, H. C.; Chou, Y. T. (Lehigh Univ., Bethlehem, PA). Metall. Trans.; 6A: No. 7, 1453-1458(Jul 1975).

The elastic energy of a two-dimensional slit crack in bcc refractory metals (Fe, Nb, Ta, Cr, V, Mo, and W) is analyzed as a function of crystallographic orientation. Approximate energy expressions are obtained for cracks lying on (100), (110), and (111) planes. The distinction between the mode of fracture and the mode of loading in general anisotropic solids is clarified. Cleavage fracture in bcc metals is discussed based on the energy data. (auth)

14868 DEFORMATION AND ANNEALING RESPONSE OF TD-NICKEL CHROMIUM. Kane, R. D. (Exxon Production Research Co., Houston, TX); Ebert, L. J. Metall. Trans., A; 6A: No. 7, 1465-1467(Jul 1975).

Recrystallization and grain growth processes occurring in TD-NiCr were examined with respect to deformation severity, annealing time, and temperature. Results show two different annealing responses depending on initial state and processing history prior to annealing: The as-received sheet showed a very large increase in grain size, while cold rolling produced an annealing behavior similar to primary recrystallization and normal grain growth. (DLC)

14869 INFLUENCE OF PRIOR TEXTURE ON THE COLD ROLLED TEXTURE OF Ti-6Al-4V. Frederick, S. F. (McDonnell Douglas Astronautics Corp., Huntington Beach, CA); Lenning, G. A. Metall. Trans., A; 6A: No. 7, 1467-1468(Jul 1975).

Two materials were used: annealed hot band and hand mill sheet with strong basal plane texture. Pole figures were obtained on as-rolled samples. For annealed hot band, cold rolling favors the transverse component of initial texture, cold rolling of basal textured sheet changes the texture completely to the longitudinal split type. (DLC)

14870 MECHANICAL PROPERTIES OF AN AMORPHOUS Cu-Zr ALLOY. Vitek, J. M.; Grant, N. J. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Metall. Trans., A; 6A: No. 7, 1472-1473(Jul 1975).

The material was a Cu-40 at. percent Zr splat-cooled alloy. Tensile strength was 986 MN/m^2 (143,000 psi), fracture surface was perpendicular (90°) to the tensile direction, and ductility was absent in tension and bend tests. Fracture surfaces were studied by light and scanning electron microscopy; vein patterns were found. Results are compared with these for other splat-cooled alloys. (DLC)

14871 MAGNETIZATION, MAGNETOSTRICTION, AND MAGNETOELASTIC BEHAVIOR OF SOME FERRIMAGNETIC, INTERMETALLIC RARE-EARTH COBALT COMPOUNDS (R_2Co_{17}). D'silva, T. L. Notre Dame, IN; Univ. of Notre Dame (1975). 158p. University Microfilms Order No. 75-13,086.

Thesis (Ph. D.).

Saturation magnetization and two magnetostriction constants (lambda/sup gamma/ and lambda/sup epsilon/), from 77.4 to 450°K, of the intermetallic compounds and pseudobinaries were

determined. All samples were single crystals grown by a floating zone technique. The saturation magnetization was determined on a vibrating sample magnetometer and magnetostriction was measured with foil strain gages. The yttrium and lutetium ions being nonmagnetic Y_2Co_{17} and Lu_2Co_{17} showed typical ferromagnetic behavior. The other compounds which contain the magnetic ions Dy and Tm, exhibit ferrimagnetic coupling between the rare-earth and cobalt sublattices. Over the entire temperature range of measurement, Dy_2Co_{17} showed an easy basal plane as compared to Tm_2Co_{17} which has an easy c-axis. The magnetostriction constant lambda/sup gamma/ for the Dy sublattice in the Dy containing compounds was found to obey single-ion behavior. The magnitude of saturation magnetostriction in these compounds is of the order of 100 mu in./in. which compares with existing metallic magnetostrictive materials. (Diss. Abstr. Int., B)

14872 STACKING FAULTS AND PRE-PRECIPITATION IN NICKEL-BERYLLIUM ALLOYS. Rao, V. D. Detroit, MI; Wayne State Univ. (1974). 202p. University Microfilms Order No. 75-13,376.

Thesis (Ph. D.).

The variation of stacking fault probability as a function of Be (solute) concentration was investigated in Ni–6 to 14 at. percent Be alloys. Stacking fault energy of the alloys was estimated and is presented as a function of Be and also as a function of normalized solute concentration $(c/1+c)^2$, where c equals x/x^*, x is the solute concentration and x^* is the solute concentration at solubility limit). Cu–6.6 to 9.8 at. percent Si alloys were also investigated for comparison. (Diss. Abstr. Int., B)

14873 PLANE STRAIN FRACTURE TOUGHNESS (K_{Ic}) DATA HANDBOOK FOR METALS. Matthews, W. T. (Army Materials and Mechanics Research Center, Watertown, MA). Int. J. Fract.; 10: No. 1, 439-440(Mar 1974).

The K_{Ic} data in the handbook were obtained by quasi-static loading in a neutral laboratory environment. No data are included for dynamic loading or corrosive environmental conditions. Whenever possible, data were selected for presentation after comparison with independent results. Each toughness datum entry includes the material form from which the specimen was obtained, the specimen dimensions, and its orientation relative to the material form and the materials composition, heat treatment and yield strength, and the test temperature. The effects of specimen orientation and test temperature are presented in tables. (auth)

14874 SOME OBSERVATIONS OF SIH'S STRAIN ENERGY DENSITY APPROACH FOR FRACTURE PREDICTION BY I. FINNIE AND H. O. WEISS. Sih, G. C. (Lehigh Univ., Bethlehem, PA). Int. J. Fract.; 10: No. 1, 279-283(Mar 1974).

Fracture experiments were conducted on Be sheets to compare fracture angles at initiation with those predicted based on the maximum tensile stress criterion and the strain energy density criterion. It is concluded that the strain energy density criterion provides a more consistent framework for the prediction of material failure than does the maximum tensile stress angle criterion. (JRD)

14875 EFFECT OF ORTHOTROPY IN A CRACKED CYLINDRICAL SHELL. Erdogan, F.; Ratwani, M.; Yeuceoglu, U. (Lehigh Univ., Bethlehem, PA). Int. J. Fract.; 10: No. 1, 369-374(Mar 1974).

A pressurized cylindrical shell containing a longitudinal crack is considered. It is assumed that the material has a special orthotropy, namely that the shear modulus of the sheet may be evaluated from the measured Young's moduli and the Poisson's ratios rather than being an independent material constant. Two examples, one for a mildly orthotropic (titanium) and the other for a strongly orthotropic (graphite) material approximately satisfying the condition of special orthotropy are given. The results show that the stress intensity factors are rather strongly dependent on the degree of orthotropy. (auth)

14876 EQUILIBRIUM PHASE DIAGRAM AND CRYSTAL STRUCTURES OF THE INTERMEDIATE PHASES OF THE Ba–Cd BINARY SYSTEM. Bruzzone, G. (Univ. of Genoa). J. Less-Common Met.; 41: No. 1, 193-194(Jun 1975).

In a short communication (J. Less-Common Metals, 39 (1975) 181) R. T. Dirstine has reported on the barium-cadmium phase diagram. It should be noted however, that this system, together with that of calcium-cadmium, has previously been the subject of a study published by Bruzzone (Gazz. Chim. Ital., 102 (1972) 234) and that the work described by Dirstine confirms, but does not add to, the work already published. The phase diagram given by Bruzzone is reproduced and is included for comparison. (auth)

14877 MOESSBAUER EFFECT STUDY OF THE PSEUDO-BINARY SYSTEM $Ce(Fe_{1-x}Co_x)_2$. Longworth, G. (Atomic Energy Research Establishment, Harwell, Eng.); Harris, I. R. J. Less-Common Met.; 41: No. 1, 175-185(Jun 1975).

The pseudo-binary system between $CeFe_2$ and $CeCo_2$ has been studied by means of the ^{57}Fe Mössbauer effect and by x-ray diffraction. The alloys prepared are in the predominantly single-phase condition across the whole system after a prolonged homogenization treatment. The variation of the hyperfine interactions at the iron sites and of the Curie temperature are discussed in terms of a model in which they depend upon the local electronic environment. (auth)

14878 CRYSTALLOGRAPHIC AND MAGNETIC INVESTIGATIONS OF $Gd_2(Fe,Ni)_{17}$ ALLOYS. Steiner, W.; Hrubec, J. (Technische Hochschule, Vienna). J. Less-Common Met.; 41: No. 1, 165-174(Jun 1975).

Crystallographic and magnetic investigations of alloys with the nominal composition $Gd_2(Fe_{1-x}Ni_x)_{17}$ are reported. Up to $x = 0.4$ a statistical substitution of Fe by Ni atoms is possible, if at the same time an increasing excess of Gd over the stoichiometric composition is used. For $0.5 \leq x \leq 0.9$, two-phase samples were obtained consisting of $Gd(Fe,Ni)_5$ together with either α-Fe or γ-(Fe,Ni), depending upon the value of x. The magnetic measurements show ferrimagnetic coupling between the spins of the Gd and the 3d atoms. Up to $x = 0.4$, the shape of the mean-3d-moment vs. x curve is similar to that in the binary (Fe,Ni) system and can be explained by the filling up of the 3d bands. The influence of the conduction electrons on the mean 3d moments is small in this concentration region, but strong for Gd_2Ni_{17}, where 0.34 μ_B was found for a Ni atom. The Curie temperatures increase with increasing x values and show a maximum for $x = 0.3$. (auth)

14879 SUPERCONDUCTING TRANSITION TEMPERATURE IN MARTENSITIC TITANIUM-BASE TRANSITION-METAL BINARY ALLOYS. Collings, E. W. (Battelle Columbus Lab., OH); Ho, J. C. J. Less-Common Met.; 41: No. 1, 157-164(Jun 1975).

Quenched, martensitic, titanium-base, transition-metal-binary (Ti–T_3) alloys exhibit unusually rapid increases in superconducting transition temperature, T_c, with solute concentration. Indeed, in Ti–Mo it has been proved that T_c is much higher than would be expected on a purely density-of-states basis. The general enhancement of T_c in the martensitic alloys is thought to be a result of a lattice-disorder-induced "soft-phonon" mechanism. Among the various Ti–T_2 alloys, the rates of increase of T_c with electron/atom ratio (ζ) vary inversely as the "distance" between Ti and T_2 in the Periodic Table. This is believed to be due to variation in lattice (solution) strengthening, which tends to offset lattice disorder as a promotor of superconductive electron coupling. (auth)

14880 CRITICAL EFFECTS IN THE ELECTRICAL RESISTIVITY OF SAMARIUM. Krithivas, G. (Brandeis Univ., Waltham, MA); Meaden, G. T. J. Less-Common Met.; 41: No. 1, 149-156(Jun 1975).

Logarithmic divergences are reported for the 14°K magnetic critical point of samarium in both electrical-resistivity and heat-capacity data. This agrees with the Fisher-Langer and Mannari critical scattering theories. It is also shown that application of de Gennes' magnetic resistivity relation to the second transition point at 104°K yields reasonable values for the exchange constant and the effective mass of the conduction electrons. (auth)

14881 CRYSTAL STRUCTURE OF Au_9In_4(h) AND Au_7In_3. Puselj, M.; Schubert, K. (Max-Planck Inst. fuer Metallforschung, Stuttgart). J. Less-Common Met.; 41: No. 1, 33-44(Jun 1975). (In German).

The phase Au_9In_4(h) crystallizes in the Cu_9Al_4-type structure and Au_7In_3 has a hexagonal crystal structure with 60 atoms in the elementary cell. The structure is related to the γ-brass structure but with a different distribution of vacancies and another system of displacements. A spatial correlation of the core electrons with a very simple commensurability may be traced in the structure, together with a valence electron correlation which is geometrically related to the core electron correlation by a factor of 2. This energetically favorable binding relationship provides an argument in favor of the stability of Au_7In_3. (auth)

14882 PHASE EQUILIBRIA IN THE SILVER–CERIUM SYSTEM. Delfino, S.; Ferro, R.; Capelli, R.; Borsese, A. (Univ., Genoa). J. Less-Common Met.; 41: No. 1, 59-64(Jun 1975).

The Ag–Ce system has been studied by thermal and differential thermal analysis, chemical analysis, and metallographic

and x-ray examinations. The following phases were observed: Ag_5Ce (peritectic decomposition 835 ± 10°C), $Ag_{51}Ce_{14}$ (mp 1040 ± 10°C), Ag_2Ce (peritectic decomposition 855 ± 5°C), AgCe (mp 870 ± 10°C). Three eutectics occur: Ag–Ag_5Ce (10.0 ± 0.5 at.% Ce, 800 ± 5°C), Ag_2Ce–AgCe (43.5 ± 0.5 at.% Ce, 780 ± 5°C), AgCe–Ce (81.6 ± 0.5 at.% Ce, 510 ± 5°C). (auth)

14883 STRUCTURE OF Nb_5Ga_3. Brown, P. W.; Worzala, F. J. (Univ. of Wisconsin, Madison). J. Less-Common Met.; 41: No. 1, 77-85(Jun 1975).

The phase sequence on the Nb-rich phases of the Nb–Ga binary-phase system was examined. X-ray analyses were conducted on arc-melted, annealed and powdered specimens whose compositions ranged from 28 to 45 at.% Ga. Three intermediate phases, Nb_3Ga, Nb_5Ga_3 and Nb_8Ga_1, were observed. The presence of a phase corresponding to the formula Nb_3Ga_2 was not detected. The presence of an hexagonal, oxygen-stabilized phase, $Nb_5Ga_3O_x$, was also observed. Indications are that the Nb_5Ga_3 single-phase region is very narrow. (auth)

14884 QUANTITATIVE NON-DESTRUCTIVE MAGNETIC ANALYSIS OF OXYGEN IN A SCANDIUM SINGLE CRYSTAL. Greiner, J. D.; Smith, J. F. (Ames Lab., Iowa). J. Less-Common Met.; 41: No. 1, 129-133(Jun 1975).

The Faraday technique was employed to determine the principal magnetic susceptibilities of a scandium single crystal at room temperature, with several field strengths in the range 6 to 11 kOe. The field-dependence of the experimental data was weak, and it was deduced that only about 15% of the 60 ppM of iron, indicated by chemical analysis to be present in the starting material, was clustered to a sufficient extent to couple ferromagnetically. Bulk paramagnetic susceptibilities were obtained in the standard manner from reciprocal-field plots up to infinite-field values. The bulk susceptibilities were interpreted as indicating an oxygen content of 1.8 ± 0.3 at.% in the crystal. This interpretation used the extensive data of Spedding and Croat as a standard for the magnetic susceptibilities of pure scandium, and used their results for the effects, on the susceptibility, of various impurities. The validity of the oxygen analysis was substantiated by vacuum-fusion analysis on an equivalent piece of scandium metal. (auth)

14885 CRYSTAL STRUCTURE AND TWIN LAMELLAE OF Ni_3Ta. Saburi, T.; Nakamura, M.; Nenno, S. (Osaka Univ.). J. Less-Common Met.; 41: No. 1, 135-139(Jun 1975).

The structure of Ni_3Ta has been examined by electron microscopy. The crystal structure of bulk Ni_3Ta was observed to be a long-period superstructure of AB_3(12)S-type. Metallographically-observed lamellae were found to be thin plates, twin-related to each other with respect to the close-packed (001) plane. (auth)

14886 CREEP PROPERTIES OF CVD TUNGSTEN. Farrell, K. (Oak Ridge National Lab., TN). pp 439-455 of Chemical Vapor Deposition. Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

The creep-rupture properties of sheet specimens of tungsten prepared by chemical vapor deposition from the fluoride phase are summarized. Tests were performed at 1400, 1650, and 2200°C in vacuum. There is a wide scatter in the data which can be rationalized by classification into two groups, low (2 to 9 ppM) fluorine and high (12 to 35 ppM) residual fluorine levels. At 1650°C where a clear distinction can be made, the low fluorine materials have minimum creep rates equal to, or perhaps a little greater than, those of powder metallurgy tungsten; at high fluorine levels and high stresses the creep rates are significantly less. Ductility varies widely but is generally less than that of powder metallurgy tungsten and is reduced with increasing fluorine content at all test temperatures. Concurrently, intergranular cavitation and fracture are encouraged. Grain boundary migration mitigates the deleterious effects of cavities, and ductility and rupture life are enhanced if grain growth occurs during the test. (11 figures, 27 references) (auth)

14887 ANISOTROPIC OPTICAL PROPERTIES OF HEAVY-RARE-EARTH SINGLE CRYSTALS. Weaver, J.H. (Physical Sciences Laboratory, University of Wisconsin-Madison, Stoughton, Wisconsin 53589); Lynch, D.W. Phys. Rev. Lett. 34: No. 21, 1324-1327 (26 May 1975).

The optical absorptivities of oriented single crystals of hcp Gd, Tb, Dy, Ho, Er, Tm, and Lu were measured at 4.2 K between 0.2 and 4.4 eV. Polarized radiation was used to reveal the optical anisotropy. Systematic movement of structures in the absorptivity and optical conductivity was observed as a result of trends within *sp* and *d* bands. Low-energy structures were related to effects of *s-f* exchange interaction, but were more complicated than previously thought. (auth)

14888 MAGNETIC ORDER IN THE PSEUDO-BINARY SYSTEM $Th(Fe_{1-x}Ni_x)_5$. Elemans, J. B. A. A. (Reactor Centrum Nederland, Petten); Buschow, K. H. J.; Zandbergen, H. W.; de Jong, J. P. Phys. Status Solidi A.; 29: No. 2, 595-600(16 Jun 1975).

Neutron diffraction results at room temperature and 4.2°K are presented for members of the series $Th(Fe_{1-x}Ni_x)_5$ crystallizing in the hexagonal $CaCu_5$ structure type. At low x, ferromagnetic (parallel to the c-axis) and antiferromagnetic (perpendicular to the c-axis) spin components occur simultaneously; at intermediate x, the ferromagnetic component appears to be accompanied by a ferrimagnetic component of the moments perpendicular to the c-axis. The concentration dependence of the saturation magnetization and the Curie temperature of the compounds $Th(Fe_{1-x}Ni_x)_5$ are compared with those of the series $La(Fe_{1-x}Ni_x)_5$. This latter series gives rise to the $CaCu_5$ type of structure only for $x \geq 0.7$. The magnetic properties of the compounds $Th(Fe_{1-x}Ni_x)_5$ favor an interpretation in terms of a localized model in which the Fe moments induce a small moment on neighboring Ni atoms. (auth)

14889 HYDROGEN RELAXATION PEAK IN NIOBIUM. Schiller, P.; Schneiders, A. (EURATOM, Ispra, Italy). Phys. Status Solidi A.; 29: No. 2, 375-379(16 Jun 1975).

An investigation was made on the influence of oxygen on the so-called hydrogen Snoek peak in niobium. It could be shown that the peak is due to hydrogen bonded to oxygen impurities. The peak-height depends on the hydrogen concentration in a way which confirms the model of hydrogen bonded to oxygen on well defined sites. Results are similar for deuterium. (auth)

14890 TRANSITION FROM WEAK FERROMAGNETISM TO PARAMAGNETISM IN $Zr(Fe_{1-x}Co_x)_2$. Hilscher, G.; Kirchmayr, E. (Technische Hochscule, Vienna). Phys. Status Solidi A.; 29: No. 2, K169-K172(16 Jun 1975).

Magnetic measurements were performed in a PAR vibrating sample magnetometer in fields up to 68 kG and at temperatures from 4 to 300°K. Spontaneous magnetization, Curie point, and initial susceptibility were determined. It is shown that the magnetic phase transition can be treated within the Stoner–Wohlfarth theory. (DLC)

14891 ENTHALPY AND HEAT CAPACITY OF NIOBIUM. Kozhevnikov, I.G. High Temp. 12: No. 4, 785-786 (Mar 1975).

The temperature dependence of the heat capacity and enthalpy of niobium in the range 400 to 2700°K was measured, using the method of mixing. (AIP)

14892 MEASUREMENT OF THE IMPACT IONIZATION RATE IN N—TYPE InSb. Pogreb, R.M.; Borodovskii, P.A. (Institute of the Physics of Semiconductors, Siberian Branch, Academy of Sciences of the USSR, Novorsibirsk). Sov. Phys.–Semicond. 8: No. 12, 1503-1505 (June 1975).

The rate of impact ionization in a dumbbell-shaped sample of n-type InSb was investigated in electric fields up to 600 V/cm at 77°K. A comparison was made of the experimental results with the theory and the influence of an external magnetic field on the impact ionization rate was investigated. A negative magnetoresistance was observed in electric fields of ~400 V/cm. (auth)

14893 SUPERCONDUCTIVITY OF VAPOUR QUENCHED BERYLLIUM AND BERYLLIUM-BASED ALLOYS. Granqvist, C. G.; Claeson, T. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik). Z. Phys., B.; 20: No. 1, 13-20(1975).

9 figs.; 1 tab.; 52 refs.

The properties of Be films, quench-condensed upon a ^{3}He cooled substrate, were investigated by resistance and tunneling measurements. The superconducting transition temperature of Be films increased with thickness and a thick film limit of 9.95 K could be estimated. Alloying with Al or Pb decreased the transition temperature. The ratios between energy gaps and transition temperatures indicated that Be is a weak coupling superconductor, and no phonon induced structure could be traced in tunneling curves either in pure Be or in the Be based alloys. Resistance change during annealing as well as superconducting data indicated that the vapor-quenched Be films were amorphous as deposited. (GE)

14894 STRUCTURAL AND MAGNETIC PHASE TRANSITIONS IN METALLIC SINGLET GROUND STATE SYSTEMS. Fulde, P. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (F. R. Germany)). Z. Phys., B.; 20: No. 1, 89-94(1975).

5 figs.; 1 tab.; 9 refs.

Metallic singlet ground state systems often have anomalous elastic properties which result from the coupling of the phonons to the crystal field energy levels of the rare earth ions. It is

shown that structural and magnetic phase transitions should occur in the same way in those systems. They are caused by a sufficiently strong electron-ion interaction. While the orbital part of this interaction is responsible for possible structural phase transitions, the spin dependent part is responsible for magnetic phase transitions. This is demonstrated in detail by considering as an example the aspherical Coulomb charge scattering and the isotropic exchange interaction. A calculation of the sound velocity, the sound attenuation and the excitations in the presence of the aspherical Coulomb charge scattering is given. Furthermore, the mutual coupling of structural and magnetic phase transitions are discussed. This includes a consideration of other types of coupling than aspherical Coulomb scattering and isotropic exchange. (auth)

14895 MOESSBAUER EFFECT OF ^{119}Sn IN AMORPHOUS SUPERCONDUCTING METALS. Bolz, J.; Pobell, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Z. Phys., B.; 20: No. 1, 95-103 (1975).

10 figs.; 1 tab.; 33 refs. Part of a thesis by J. Bolz.

Moessbauer spectra for ^{119}Sn in crystalline and disordered Sn, as well as in crystalline and liquid-like amorphous Sn(Cu) were measured at 2.6 K $<= T <=$ 108 K. The Debye-Waller-Factor (DWF) obtained from the spectra is identical for the crystalline and for the disordered phase. The DWF of the amorphous phase is smaller than the DWF of the crystalline phase at high temperatures, but it shows a stronger temperature dependence than the DWF of the crystalline phase and reaches the latter one at about 4 K. From this low-temperature result, it was concluded that the differences of the Eliashberg function $\alpha^2(\omega)F(\omega)$ and of the superconducting transition temperature in these two phases cannot be related to changes in the phonon spectrum $F(\omega)$, but must result from changes of the interaction parameter $\alpha^2(\omega)$. A comparison between DWF, α^2F, and specific heat data is performed. From the values for the isomeric shift of the Moessbauer line, it can be shown that the hybridization and covalency of the electronic bonds present in the crystalline and in the disordered phases are destroyed in the amorphous phase. Both the DWF and the isomer shift demonstrate that the electronic properties of crystalline and amorphous Sn(Cu) differ appreciably. The electronic and superconducting properties of amorphous Sn(Cu) are similar to the properties of the high pressure phase of tin. (auth)

14896 MOESSBAUER EFFECT STUDIES OF INTERCONFIGURATION FLUCTUATIONS IN METALLIC RARE EARTH COMPOUNDS. Bauminger, E. R.; Felner, I.; Froindlich, D.; Levron, D.; Nowik, I.; Ofer, S.; Yanosky, R. (Hebrew Univ., Jerusalem (Israel)). J. Phys. (Paris), Colloq.; No. 6, 61-70(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Recoilless absorption spectra of the 21.6 keV gamma ray in ^{151}Eu in $EuCu_2Si_2$ and $EuRh_2$ reveal a single absorption line which has a strongly temperature dependent isomer shift. The recoilless absorption spectra in $Eu(x)La(1-x)Rh_2$ ($0.075 <= x <= 0.5$), $Eu(0.125)Pr(0.875)Rh_2$ and $EuRh(2-x)Pt(x)$ ($0.125 <= x <= 1$) are composed of a few lines, many of which also exhibit strongly temperature dependent isomer shifts. Each line in these spectra is attributed to a different Eu site characterized by the number of La, Pr or Pt nearest neighbors. The isomer shifts of many of the lines correspond to neither Eu^{3+} nor Eu^{2+} valencies, but fall in between. All the results are interpreted in terms of fast fluctuations (tau $< 4 \times 10^{-11}$s) between the $4f^6$ and $4f^7$ configurations. The energy necessary to make an interconfiguration excitation from $4f^6$ to $4f^7$, by removing an electron from the conduction band at the Fermi level and placing it in the localized 4f level, is approximately 800°K in $EuCu_2Si_2$ and approximately 1200°K in $EuRh_2$. In the ternary compounds, this energy depends significantly on the number of La, Pr or Pt nearest neighbors of the Eu ions, and is somewhat temperature dependent. The localized 4f levels have an energy width of about 100°K. The recoilless absorption spectra in Yb metal of the 84 keV gamma ray in ^{170}Yb emitted by a $^{170}Tm(x)Ho(1-x)Fe_2$ source are composed of two subspectra, one of which is a 5 line split spectrum and the other is a broadened line at zero velocity. These spectra are also interpreted in terms of interconfiguration fluctuations ($4f^{14}-4f^{13}$). (FR)

14897 THE CONTACT CHARGE DENSITIES OF 4S ELECTRONS OF Fe IMPURITIES ATOM IN SOME TRANSITION AND NOBLE METALS. Shinoara, T.; Onodera, H.; Yamamoto, H.; Watanabe, H. (Tohoku Univ., Sendai (Japan). Research Inst. for Iron, Steel and Other Metals); Fujioka, M.; Hisatake, K. (Tokyo Inst. of Tech. (Japan)). J. Phys. (Paris), Colloq.; No. 6, 215-219(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The internal conversion electrons from M and N shells of the 14.4 keV transition of ^{57}Fe diffused into Cr, Ni, Cu, Pt, and Au substrates were measured using a high-resolution β-ray spectrometer. The contact charge density of 4s electrons ρ_{4s} of ^{57}Fe impurity atom in these host metals was deduced from relative intensities of conversion electrons analyzed using a deconvolution method. The 4s contact charge density of ^{57}Fe embedded in these host metals as well as Fe and Co metals is found to be nearly equal. This fact indicates that the 3s contact charge density ρ_{3s} plays an important role in the variation of the isomer shift of ^{57}Fe in these alloys. (FR)

14898 RELAXATION OF 3D AND 4F ELECTRONS IN METALS AND ALLOYS. Hirst, L. L. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). J. Phys. (Paris), Colloq.; No. 6, 21-31(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The study of the electronic relaxation of 3d and 4f impurities in metals by means of their slow-relaxation Moessbauer spectra is reviewed. The effect of ionic-type splittings, such as crystal-field splittings of 4f impurities and the effects of slow intraconfigurational rearrangement in Moessbauer source spectra are especially emphasized. The information obtainable from the Moessbauer method is compared with that obtainable from EPR. (FR)

14899 VOLUME DEPENDENCE OF HYPERFINE INTERACTIONS. Kalvius, G. M.; Klein, U. F.; Wortmann, G. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). J. Phys. (Paris), Colloq.; No. 6, 139-149(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The influence of changes in atomic volume on the three types of hyperfine interactions (the isomer shift, the quadrupole coupling and the magnetic dipole interaction) is reviewed. The volume dependence of a hyperfine interaction is usually obtained from high-pressure experiments, which are discussed in some detail. Particular emphasis is given to the interpretation of the volume coefficients of the Moessbauer isomer shift in metals and compounds. The volume coefficient of a hyperfine interaction can be used to interpret other phenomena which are accompanied by volume changes. A typical example is the temperature dependence of hyperfine interactions in solids. A selection of measurements of this kind is discussed to give some insight into the problems connected with such investigations. (FR)

14900 FLUXOID PINNING IN NIOBIUM CONTAINING SMALL AMOUNTS OF YTTRIUM OR GADOLINIUM. Koch, C. C.; Kroeger, D. M. (Oak Ridge National Lab., Tenn. (USA). Metals and Ceramics Div.). Philos. Mag.; 30: No. 3, 501-513(Sep 1974). (AED-CONF-74-516-003).

From international discussion meeting on flux pinning in superconductors; St. Andreasberg, F. R. Germany (23 Sep 1974). 6 figs.; 2 tabs.; 20 refs. With abstract.

The fluxoid pinning of niobium containing small amounts of either yttrium or gadolinium (<= 2 at.%) was determined by direct current magnetization measurements on specimens in the heavily-deformed, partially-recovered, and recrystallized conditions. Optical and electron microscopy were used to characterize the samples. Magnetic hysteresis of Nb was increased by the additions of Y or Gd. In the cold-worked condition increased pinning was due to planar sheets and stringers of Y(Gd) produced by the deformation and parallel to the fluxoid axes. The fluxoid pinning was a function of Y(Gd) concentration. In the recrystallized samples the high-angle grain boundaries were the most important pinning sites and the pinning was independent of Y(Gd) content. (auth)

14901 JAHN-TELLER EFFECTS IN MOESSBAUER SPECTROSCOPY. Ham, F. S. (General Electric Co., Schenectady, N. Y. (USA). Research and Development Center). J. Phys. (Paris), Colloq.; No. 6, 121-130(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The consequences for the Moessbauer spectrum of coupling between asymmetric vibrational modes and an electronic state having orbital degeneracy (the Jahn-Teller (JT) effect) are examined. Characteristic modifications of the quadrupole coupling by a spontaneous JT distortion (static JT effect) and by a dynamic coupling of electronic and vibrational motions (dynamic JT effect) are discussed with the aid of a simplified model. The importance of small crystal strains in determining the type of spectrum observed is discussed, as is also the role of thermally induced transitions in causing motional averaging of the spectrum. Exam-

ples are given of JT effects as observed or anticipated in the Moessbauer spectrum of Fe^{3+} in crystal sites with tetrahedral and octahedral coordination. (FR)

14902 AMORPHOUS SOLIDS: A REVIEW OF THE APPLICATIONS OF THE MOESSBAUER EFFECT. Coey, J. M. D. (Centre National de la Recherche Scientifique, 38- Grenoble (France). Lab. de Magnetisme). J. Phys. (Paris), Colloq.; No. 6, 89-105(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The Moessbauer effect has been used intensively to help investigate the structure and bonding of oxide and chalcogenide glasses, particularly those containing iron, tin, tellurium, and antimony. Both the properties of magnetically ordered amorphous iron compounds and alloys and the glass transition have been examined. After an introduction to some elementary ideas of amorphous solids, the information obtained from the Moessbauer studies of their structure, bonding, and magnetic properties is reviewed. An attempt is made to assess both the scope of the technique and its future prospects in this field. (FR)

14903 CORRELATION OF THE MOESSBAUER ISOMER SHIFT WITH THE X-RAY CHEMICAL SHIFT FOR Au IN Cu_3Au. Roberts, L. D.; Josephson, W. D.; Knoble, D. W. (North Carolina Univ., Chapel Hill (USA)). J. Phys. (Paris), Colloq.; No. 6, 225 (1974).

From international conference on the applications of the Moessbauer effect; Bendor, France(2 Sep 1974).

The Moessbauer isomer shift and the x-ray chemical shift were measured for ^{197}Au in Cu_3Au relative to metallic gold. These are compared through appropriate theory. The results agree with the sign and approximately with the value for $\Delta r/r$ for the ^{197}Au nucleus which was obtained earlier. (FR)

14904 STUDY OF THE STRUCTURE OF AUSTENITIC ALLOYS OF INCONEL 600 TYPE AND ITS DEVELOPMENT DURING HEAT TREATMENTS. Berge, P.; Donati, J. R.; Guttmann, D.; Laurent, D.; Palous, S. (Electricite de France, 77-Ecuelles). Mem. Sci. Rev. Metall.; 71: No. 12, 773-786(Dec 1974). (In French).

From 13th meeting on alloy steels; Saint-Etienne, France (16 May 1974).

The changes observed in the structure of austenitic alloys of Inconel 600 type during solution heat-treatment and aging were studied. The dechromization due to chromium carbide precipitation was investigated. The Inconel 600 intergranular corrosion testing is described including electrochemical tests and 24-hour tests in aqueous ferric sulfate. (FR)

14905 OBSERVATION OF THE CARBON ROLE IN THE DEVELOPMENT, BY HEATING, OF THE MARTENSITIC STRUCTURE OF A STEEL WITH 12% Cr AND 0.10%C, USING HIGH-RESOLUTION AUTORADIOGRAPHY (^{14}C). Relationship Between the Structure and the Mechanical Properties. Prabhu Gaunkar, G. V.; Huntz, A. M.; Severac, C.; Lacombe, P. (Paris-11 Univ., 91-Orsay (France)). Mem. Sci. Rev. Metall.; 71: No. 12, 787-795(Dec 1974). (In French).

From 13th meeting on alloy steels; Saint-Etienne, France (16 May 1974).

The microautoradiographic technique with high resolving power for ^{14}C loaded thin plates was used to study the C role during the tempering of the martensitic structure of a steel containing 12% Cr by weight. The simultaneous electron microscopy studies of the autoradiographies and thin plates allow very low C segregations to be observed. The changes in the structure and mechanical properties were investigated over the whole heat-treatment range (from 100 to 750°C). A relationship was established between the changes in the mechanical properties and the C distribution in the microstructure. (FR)

14906 CRYSTAL FIELDS AND MAGNETIC PROPERTIES OF $NdSn_3$, $NdPb_3$ AND $NdIn_3$. Lethuillier, P.; Pierre, J. (Centre National de la Recherche Scientifique, 38 - Grenoble (France). Lab. de Magnetisme); Knorr, K.; Drexel, W. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). J. Phys. (Paris).; 36: No. 4, 329-333(Apr 1975).

Inelastic neutron scattering experiments were performed on the intermetallic compounds $NdPb_3$ and $NdSn_3$. Well resolved transitions between crystal field levels were observed at different temperatures and for each compound, two level schemes were possible. Magnetic measurements and elastic neutron scattering experiments were performed to remove this uncertainty. The experimental crystal field parameters deviate considerably from point charge estimates. (FR)

14907 CREEP PERFORMANCE AND UTILIZATION PROPERTIES OF SOME STEELS EMPLOYED IN THE NUCLEAR INDUSTRY. Mathern, G.; Decroix, J.; Lefevre, J.; Tricot, R. (Ugine Aciers, 73 - Ugine (France)). pp 48-49 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Various types of steels employed in the nuclear industry have been characterized in terms of their utilization properties: KM 33 steel (hot mechanical properties, weldability and behavior in liquid sodium); 18-10 austenitic steels (effect of C, Ti, Nb, Mo, Ni, Cu, and B on creep resistance); incoloy 800 (effect of composition on creep, mechanical strength and intergranular corrosion). (FR)

14908 SPECIAL STEELS FOR NUCLEAR POWER. Vieillard-Baron, B. (Societe Creusot-Loire, 75 - Paris (France)). pp 39-41 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Steels used in nuclear industry are described. It is shown that the combined efforts of the engineering organizations in charge of designing the components and systems, of the steel makers and the users have permitted the realization of reliable, safe and economic reactors. (FR)

14909 TEMPERATURE DEPENDENCE OF THE 6.2keV MOESSBAUER RESONANCE OF ^{181}Ta AT LOW TEMPERATURE. Salomon, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Triplett, B. B.; Dixon, N. S.; Boolchand, P.; Hanna, S. S. (Stanford Univ., Calif. (USA). Dept. of Physics). J. Phys. (Paris), Colloq.; No. 6, 285-289(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The temperature dependence of the 6.2keV Moessbauer resonance of ^{181}Ta is reported for sources of $^{181}W(W)$ and $^{181}W(Ta)$. The measurements cover the temperature range from 15K to 457K. For $^{181}W(W)$ they show substantial deviation from the anomalously large linear dependence observed previously at high temperature. Subtraction of the second order Doppler shift leaves a residual whose temperature dependence is closely proportional to the thermal expansion of W. The implications of this result are discussed. The temperature dependence for $^{181}W(Ta)$ is more nearly linear and the analysis is much less straightforward. (FR)

14910 TEMPERATURE DEPENDENCE OF THE ELECTRIC FIELD GRADIENT AT TRANSITION IMPURITIES IN CLOSE-PACKED HEXAGONAL METALS. Piecuch, M.; Janot, C. (Nancy-1 Univ., 54 (France). Lab. de Physique du Solide). J. Phys. (Paris), Colloq.; No. 6, 291-294(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The temperature dependence of the electric field gradient at transition impurities in normal close-packed hexagonal metals is shown to be consistent with an appreciable contribution from virtual bound 3d states. By studying the crystal field influence on this virtual level in a Friedel-Anderson model, the localized electronic contribution to the EFG appears to be linearly related to the density of 3d states at the Fermi level. So, the experimental data from Moessbauer spectroscopy for the temperature dependence of the EFG in the Be—Fe dilute alloy can be ascribed to the effects of localized spin fluctuations. (FR)

14911 EFFECTS OF PRESSURE ON MAGNETIC INTERACTIONS IN THE RARE EARTH INTERMETALLICS R_2Ni_{17}. Jaakkola, S.; Parviainen, S.; Stenholm, H. (Turku Univ. (Finland). Wihuri Physical Lab.). Z. Phys., B.; 20: No. 1, 109-115(1975).

4 figs.; 2 tabs.; 31 refs.

The Curie temperatures of Y_2Ni_{17} and Dy_2Ni_{17} were observed to vary with hydrostatic pressure at a rate of −0.44 K/kbar. The results for the compounds R_2Ni_{17} were compared with previously reported dTc/dp data for R_2Co_{17} and R_2Fe_{17} and discussed in terms of simplified collective and localized d-electron models. The former model suggests that R_2Ni_{17} and R_2Co_{17} are relatively far from the Stoner instability limit, while the compounds R_2Fe_{17} approach very weak itinerant ferromagnetism. The slow pressure variation of the compensation temperature of Dy_2Ni_{17}, −0.03 K/kbar, was attributed to the insensitivity of the R-Ni interaction to interatomic spacing. (auth)

14912 SHAPE CHANGES OF NIOBIUM SINGLE CRYSTALS DUE TO SYMMETRICAL PUSH-PULL CYCLING. Neumann, R. (Goettingen Univ. (F. R. Germany). Inst. fuer Metallphysik). Z. Metallkd.; 66: No. 1, 26-32(Jan 1975). (In German).

11 figs.; 1 tab.; 9 refs. Part of the thesis.

Nobium single crystals of 15 different axial orientations were cycled in push-pull at a frequency of 50 Hz. All fatigue experiments were carried out at 300 K in air. The slip systems causing the observed macroscopic shape changes were determined with the aid of a surface reference net. By means of a model it is illustrated that slip which is unevenly distributed on two sets of slip planes necessarily causes macroscopic shape changes. It is demonstrated that the observed shape changes are properly described by the model. The results agree with the known slip asymmetry in bcc metals. (auth)

14913 STRUCTURE OF ELECTROLYTICAL MAGNETIC Co–W ALLOYS. Zukauskas, R. S. M.; Rachinskas, V. S.; Gabshite, G. I.; Latvis, V. K. (Inst. of Chemistry and Chemical Technology, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 6: No. 85, 37-44(1974). (In Russian).

The dependence of change of magnetic properties, W quantity ratio, and structure of Co–W alloys on the cathodic current density (i_k), t° and pH of the electrolytes have been investigated. It has been established that increasing i_k essentially decreases the coercitivity, the size of particles, which form the microstructure of galvanic coatings, and the deviation of the sizes of particles from their middle diameter. It has been found that the main crystalline phase of electrolytical deposited Co–W alloys is α-Co. The presence of solid solution of W in the α-Co is assumed. It has been shown that the homogenization of microstructure of Co–W alloys promotes the increasing of the hysteresis loop squareness coefficient. (auth)

14914 POSSIBLY MIXED VALENCY OF URANIUM IN $UNi_{5-x}Cu_x$. van Daal, H.J.; Buschow, K.H.J.; van Aken, P.B.; van Maaren, M.H. (Philips Research Laboratories, Eindhoven, The Netherlands). Phys. Rev. Lett. 34: No. 23, 1457-1460 (9 June 1975).

This paper reports the lattice constant at room temperature and the susceptibility, specific heat, electrical resistivity, and absolute Seebeck coefficient of compounds $UNi_{5-x}Cu_x (0 \leqslant x \leqslant 5)$ as a function of temperature. It is suggested that the drastic change in the properties of these compounds when x, increasing from 0, comes into the range of 4 to 5 is caused by a change of the uranium ions from a U^{4+} to a mixed $U^{4+}-U^{3+}$ state. (auth)

14915 5*f*-ELECTRON EXCITATION ENERGIES AND THE COULOMB TERM, *U*, IN THE LIGHT ACTINIDE METALS. Herbst, J.F. (National Bureau of Standards, Washington, D. C. 20234); Watson, R.E. Phys. Rev. Lett. 34: No. 22, 1395-1398 (2 June 1975).

Relativistic Hartree-Fock-Wigner-Seitz band calculations have been performed for the actinide metals Ac through Am in order to estimate 5*f* excitation energies. Our calculations predict that the tetravalent state (i.e., four *s-d* conduction electrons) is favored for the lighter elements with a crossover to a trivalent ground state occurring near uranium. We find the Coulomb energy, *U*, for 5*f* electron hopping to increase from 2–3 eV at Th to 4–5 eV at Am. (auth)

14916 CURRENT SHARING IN A FULLY STABILIZED SUPERCONDUCTOR. Kuroda, K. (Central Research Laboratory, Hitachi, Ltd., Kokubunji, Tokyo, Japan). J. Appl. Phys. 46: No. 7, 3160-3166 (July 1975).

The dynamic behavior of a fully stabilized superconducting composite is studied by observing terminal voltages V, temperatures T, and magnetic fields H_b as a function of transport currents I without an applied magnetic field. The current sharing in the resistive state of the composite is confirmed by measuring H_b in the vicinity of a composite in which superconducting filaments are arranged in a special configuration in a copper matrix. An observed I-H_b diagram agreed well with that calculated from a fraction of the current sharing obtained from analyzing an observed I-V diagram, under an assumption which regarded the composite as a parallel circuit composed of superconducting filaments and a copper matrix. In the resistive state, it was confirmed that the current in filaments exceeded the critical current of the bare filaments and the differential resistance of the composite was smaller than the resistance of the copper matrix. (auth)

14917 EFFECT OF IMPURITIES ON THE ELECTRICAL CONDUCTIVITY OF TUNGSTEN AT LOW TEMPERATURES. Batdalov, A.B.; Tamarchenko, V.I.; Shalyt, S.S. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 16: No. 11, 2124-2126 (May 1975).

The temperature dependence of the electrical resistivity of tungsten single crystals containing various amounts of impurities has the general form $\rho = \rho_0 + AT^2 + BT^5$. The way in which the impurity content affects ρ_0, A, and B has been determined experimentally in the present research. In previous articles the quadratic term in the resistivity has been attributed entirely to the action of interelectron scattering. Analysis of the relationship A (ρ_0) has led to the conclusion that in tungsten at low temperatures there is, in addition to phonon, impurity (elastic), and mutual scattering of the current carriers, still another impurity mechanism, which is a quadratic function of temperature and is due to scattering of the current carriers by dynamic disturbances at those points in the crystal lattice where the impurities are situated. Such a scattering mechanism has been discussed theoretically in an article by Kagan and Zhernov. (auth)

14918 THE ELECTRIC FIELD GRADIENT IN CADMIUM METAL AND THE DECAY OF ^{115m}Cd. Rosenblum, S. S.; Steyert, W. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Phys. Lett., A; 53: No. 1, 34-36(19 May 1975).

Using the anisotropy of γ-rays ^{115m}Cd nuclei oriented in a cadmium single crystal at low temperatures, the electric field gradient is measured as $V_{zz} = +(1.29 \pm 0.37) \times 10^{15}$ esu/cm^3. Mixing ratios of several γ-rays are also reported. (auth)

14919 HIGH DISORDER EFFECTS IN SUPERCONDUCTING Nb_3Sn AFTER HEAVY ION IRRADIATION AT LOW TEMPERATURE. Besslein, B.; Ischenko, G.; Klaumuenzer, S.; Mueller, P.; Neumueller, H.; Schmelz, K.; Adrian, H. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Physikalisches Inst.). Phys. Lett., A; 53: No. 1, 49-51(19 May 1975).

Significant decreases of transition temperatures, transition widths and critical current densities of Nb_3Sn were measured after irradiation with oxygen ions (25 MeV) at temperatures < 30 K. Isochronal annealing shows negligible effects. Results are discussed in terms of atomic ordering. (auth)

14920 SPECTRUM OF THE ELECTRON—PHONON INTERACTION IN INDIUM. Yanson, I.K. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 16: No. 12, 2337-2341 (June 1975).

Direct measurements of the function $g(\omega) = \alpha^2(\omega)F(\omega)$ were made for indium by a previously proposed method. The second derivative of the current—voltage characteristics of point contacts of indium in the normal state were studied, and these characteristics were produced by the breakdown of metal-dielectric-metal film structures. High-resistance contacts were obtained, with a diameter much less than the electron-phonon mean free path, which avoided heating effects. The effect of temperature was studied and found to give a thermal smearing of the spectral lines by 5.4kT, and an investigation was made of the effect of heating on the electron gas in the contact region, which was observed when the contract resistance is lowered. A comparative analysis of more than 40 spectra showed a satisfactory reproducibility of the observed characteristics. The main features of the derived spectrum of the electron-phonon interaction were similar to the function $g(\omega)$ determined from tunneling characteristics in the superconducting state, but the details showed noticeable and definite differences. (auth)

14921 TEMPERATURE DEPENDENCE OF THE MAGNETIZATION OF A GADOLINIUM-YTTRIUM ALLOY SINGLE CRYSTAL. Zotov, T.D.; Epifanova, K.I.; Chuprikov, G.E. (Institute of the Physics of Metals, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.–Solid State 16: No. 12, 2412-2412 (June 1975).

Using the floating-zone method, the temperature dependence of the saturation magnetization of gadolinium and Gd+6 at.% Y single crystals were studied. The temperature range considered was 4.2–205°K.(AIP) (auth)

14922 MAGNETIC ANISOTROPY OF INTERMETALLIC R_2T_{17} COMPOUNDS. Kazakov, A.A.; Deryagin, A.V.; Kudrevatykh, N.V.; Reimer, V.A. (A. M. Gor'kii Ural State University, Sverdlovsk). Sov. Phys.–Solid State 16: No. 12, 2429-2430 (June 1975).

Comments are presented on some previously published data in the 77–1000°K range on the magnetic anisotropy constants of several rare earth-cobalt compounds.(AIP) (auth)

14923 Gd AND Ce IMPURITIES IN THE LaX_3 COMPOUNDS (X = In,Sn,Pb): A NUCLEAR-MAGNETIC-RESONANCE STUDY. Welsh, L.B. (Physics Department,Northwestern University, Evanston, Illinois 60201 and Corporate Research Center, Universal Oil Products Company, Des Plaines, Illinois 60016); Wiley, C.L.; Fradin, F.Y. Phys. Rev. B 11: No. 11, 4156-4167 (1 June 1975).

The behavior of Gd and Ce impurities in the LaX_3 (X = In,Sn,Pb) compounds has been investigated using the host-^{139}La NMR properties as a microscopic probe. The suppression of the superconducting- transition temperature T_c by these impurities was measured for $LaPb_3$. For the Gd impurities, the NMR properties (linewidth ΔH and spin-lattice relaxation rate T_1^{-1}) of the LaX_3 compounds have been used to determine the *s-f* exchange constant Γ which varies from 0.008 eV in $LaPb_3$ to 0.032 eV in $LaIn_3$. These values of Γ are substantially smaller than those found in the cubic Laves-phase compound $LaAl_2$. In contrast to the results obtained with Gd impurities in $LaAl_2$, the La NMR spin-lattice relaxation remains exponential when Gd impurities are substituted for La in the LaX_3 compounds. This indicates that the nuclear-spin diffusion barrier around the Gd sites is much smaller in the LaX_3 compounds than in $LaAl_2$.

The enhancement of the La relaxation rate by the rare-earth impurities is best accounted for by the longitudinal-dipolar mechanism. In the case of Ce impurities in the LaX_3 compounds, there is a dramatic variation in the magnetic behavior with X. In $LaSn_3$, Ce is nonmagnetic; and in $LaIn_3$, Ce appears to be magnetic with a very small value for Γ. For $LaPb_3$, the NMR data indicate paramagnetic behavior, while the magnitude of the T_c suppression with Ce can be accounted for by Kaiser's treatment of a nonmagnetic localized state. (auth)

14924 PREPARATION AND ANALYSIS OF SUPERCONDUCTING Nb-Ge FILMS. Testardi, L.R.; Meek, R.L.; Poate, J.M.; Royer, W.A.; Storm, A.R.; Wernick, J.H. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 11, 4304-4317 (1 June 1975).

The dependences of T_c, resistivity, resistance ratio, and structure on chemical composition and sputtering conditions for Nb-Ge films have been studied. The chemical composition, impurity content, and x-ray structure were obtained using Rutherford backscattering, nuclear techniques, and x-ray diffraction. Although T_c varies with composition, it is not found to be critically dependent upon exact stoichiometry; the Nb/Ge ratios vary by $\sim$ 13% (2.6 to 3) for films with $\sim$ 23-K onsets and by $\sim$ 40% (2.2 to 3.3) for films with $\sim$ 20-K onsets. For compositions similar to the bulk, the films have comparitively much higher T_c's and smaller lattice parameters. X-ray results show the films to contain predominately A-15 phase (except for Nb/Ge $\leq$ 2.5) with lattice parameters varying from 5.15 A for Nb-rich low-T_c films to 5.12 A for Ge-rich films. Several percent of oxygen and carbon occur in low-T_c amorphous films deposited at 650°C but this is considerably reduced in high-T_c films made simultaneously at $\sim$ 750°C. No argon was found and the nitrogen content was generally less than 1%. No correlation of high T_c's and impurities was found. The optimum deposition temperature and resistivity are lowest, and the resistance ratio highest for Nb/Ge ratios somewhat below 3/1. A simple correlation of T_c and resistance ratio is reported which is largely independent of all sputtering conditions and composition and which suggests that slightly higher T_c's may be possible. Negative bias was found to be detrimental to T_c while positive bias had relatively little effect. Magnetic-field-assisted sputtering led to significant increases in the sputtering rate and the optimum deposition temperature. (auth)

14925 HEAT CAPACITY OF V_3X COMPOUNDS AND THE RELATIONSHIP BETWEEN T_c AND ANHARMONICITY. Knapp, G.S.; Bader, S.D.; Culbert, H.V.; Fradin, F.Y.; Klippert, T.E. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 11: No. 11, 4331-4338 (1 June 1975).

The heat capacities of V_3Si, V_3Ga, V_3Sn, and $V_3Sn_{0.5}Ga_{0.5}$ were measured between 2 and 400 K. The high-T_c compounds V_3Ga and V_3Si have smaller high-temperature heat capacities than the two lower-T_c materials. Given the magnitudes of the measured low-temperature heat capacities, this observation can only result from unusually large anharmonicity of the higher-T_c compounds. A phenomenological model is proposed that semiquantitatively relates the electron-phonon mass enhancement, and hence T_c, to the high-temperature anharmonic heat capacity observed in these materials. The model assumes a temperature-dependent screening caused by sharp structure in the electronic density of states, which renormalizes the bare phonon-mode frequencies. (auth)

14926 ELECTROMAGNETIC GENERATION AND DETECTION OF ULTRASOUND IN SUPERCONDUCTORS. Vienneau, L.A.; Maxfield, B.W. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850). Phys. Rev. B 11: No. 11, 4339-4343 (1 June 1975).

The magnetic field dependence of electromagnetically generated and detected acoustic waves has been measured in single crystals of two type-II superconducting alloys, Pb-In and Nb-Mo. Measurements span the complete field region in the mixed state, temperatures range from 1.5 to 4.2 K, and frequencies cover the 3–90-MHz region. At frequencies where the classical skin depth $\delta_c \gg \lambda$, the acoustic wavelength, the acoustic amplitude increases as the field is decreased into the mixed state, reaches a maximum at some field below H_{c2} and then goes continuously to zero as $H \to 0$. These observations can be explained very well by a local model based upon the Lorentz force acting upon currents induced within the electromagnetic skin depth. With decreasing static magnetic field, the electromagnetic screening of the mixed state becomes increasingly more effective; the skin depth decreases from the classical skin-effect value in the normal state just above H_{c2} ($\delta_c \sim 100$ μm) to the London penetration depth ($\lambda_L \ll 1$ μm) at zero field. Using the surface resistance as a relative measure of the skin depth, good agreement is obtained between the observed and predicted values for electromagnetic acoustic-wave detection. Thus, it appears that the general features of theories used to explain electromagnetic detection of acoustic waves in normal metals are valid even when superconductive screening currents are involved. (auth)

14927 LANDAU DOMAIN STRUCTURE. III. NORMAL DOMAIN BROADENING. Farrell, D.E. (University of Southern California, Los Angeles, California 90007); Chien, M.K. Phys. Rev. B 11: No. 11, 4344-4349 (1 June 1975).

An experimental investigation has been made of the magnetic field variations at the surface of superconducting aluminum in the dynamic intermediate state. Particular attention was given to the case when the applied magnetic field made a small angle β with the sample surface. For $\beta = 10°$ our measurement imply that a normal domain experiences a fractional broadening of %typically only 2% near the surface. This is in disagreement with the 20% broadening expected on the Landau-Sharvin theory, but in good agreement with the prediction of the Krempasky-Farrell theory. (auth)

14928 NUCLEAR-INDUCED FERROMAGNETISM BELOW 50 mK IN THE VAN VLECK PARAMAGNET $PrCu_5$. Andres, K.; Bucher, E.; Schmidt, P.H.; Maita, J.P.; Darack, S. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 11, 4364-4372 (1 June 1975).

In the intermetallic compound $PrCu_5$ the $^3H_4$ multiplet of the Pr ion is crystal field split such that the lowest state is a singlet, leading to a nearly temperature-independent Van Vleck susceptibility below 4.2 K. At very low temperatures (below $\sim$ 50 mK) however, we observe ferromagnetic self-polarization of the singlet due to hyperfine and exchange interactions. Specific-heat and magnetization measurements down to 5 mK are presented and discussed in the molecular-field model of a coupled electron-nuclear system. (auth)

14929 DIRECT MEASUREMENT OF THE EXCHANGE INTERACTION BETWEEN RARE-EARTH IONS IN METALLIC VAN VLECK PARAMAGNETS. Rettori, C.; Davidov, D.; Grayevskey, A. (The Racah Institute of Physics, The Hebrew University of Jerusalem, Israel and Physics Department, University of California at Los Angeles, Los Angeles, California 90024); Walsh, W.M. Phys. Rev. B 11: No. 11, 4450-4454 (1 June 1975).

Giant g shifts have been observed in the ESR of Gd substituting the Tm or Pr in the metallic Van Vleck paramagnets TmSb, TmBi, PrSb, PrBi, and PrTe. These shifts were interpreted in terms of exchange interaction between the spin part of the Gd ions and that of the host rare-earth ions. We found this exchange interaction to be always negative, consistent with the antiferromagnetic ordering occurring in the singlet-ground-state system TbSb. The occurrence of magnetic ordering in singlet-ground-state systems is discussed in view of our results. (auth)

14930 PARAMAGNETIC RESONANCE OF Gd^{3+} AS A PROBE OF EXCHANGE AND CRYSTAL-FIELD EFFECTS IN SINGLET-GROUND-STATE SYSTEMS. Sugawara, K.; Huang, C.Y. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106); Cooper, B.R. Phys. Rev. B 11: No. 11, 4455-4462 (1 June 1975).

We have studied the use of paramagnetic resonance of dilute Gd impurities as a probe of exchange and crystal-field effects in the singlet-ground-state systems TmX and PrX (where X is one of the group-VA elements, P, As, Sb, Bi), i.e., the thulium and praseodymium monopnictides of NaCl structure. Analysis of the temperature-dependent resonance g-value behavior yields values for the Gd-Tm and Gd-Pr exchange interactions. The Gd-Tm exchange changes sign with increasing lattice parameter (on going from the phosphide and arsenide to the antimonide and bismuthide); while the Gd-Pr exchange becomes increasingly negative with increasing lattice parameter. Analysis of the temperature dependence of the linewidth yields values for the crystal-field splitting of Tm^{3+} and Pr^{3+} in agreement with those from neutron scattering. We briefly mention recent experiments using EPR of Gd in TbP to probe the behavior of the staggered susceptibility in the critical region. (auth)

14931 OPTICAL PROPERTIES OF Nb AND Mo CALCULATED FROM AUGMENTED-PLANE-WAVE BAND STRUCTURES. Pickett, W.E.; Allen, P.B. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. B 11: No. 10, 3599-3603 (15 May 1975).

Nonrelativistic band calculations of Mattheiss for Nb and Petroff and Viswanathan for Mo are used to calculate the imaginary part ϵ_2 of the dielectric function for these metals. The structure resulting from interband transitions in the frequency range 0.1–0.5 Ry is found to give fairly good agreement with experiment. The calculation indicates that structure in ϵ_2 can arise from transitions away from symmetry points and lines in the Brillouin zone. The difficulty in distinguishing between the direct and indirect transition models for ϵ_2 is shown to arise from a lack of strong optical critical points. Predictions of the rigid-band model for the optical properties of Nb-Mo alloys are presented. (auth)

Radiation Effects

Refer also to abstracts 16204, 16212, 16275, 16299, 16391, and 16564.

14932 (AECL-5028) IRRADIATION BEHAVIOR OF A CORROSION RESISTANT U–Si–Al FUEL ALLOY. Feraday, M. A.; Fehrenbach, P. J.; Cotnam, K. D.; Morel, P. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1975. 21p. Dep. NTIS (US Sales Only) $4.25. AECL $1.00.

A new corrosion resistant U–Si–Al fuel alloy clad in Zr–2.5 wt % Nb has been irradiated in pressurized water at fuel element linear power outputs of about 75 kW/m to burnups of about 275 MWh/kg U. The dimensional stability of these elements which contained a central void to accommodate swelling was better than that of similar U_3Si fueled elements. (auth)

14933 (AECL-5031) METALLURGICAL PROPERTIES OF AN IRRADIATED "XL" (ZIRCONIUM) ALLOY PRESSURE TUBE. Mooder, L. E. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1975. 26p. Dep. NTIS (US Sales Only) $4.50. AECL $1.00.

A pressure tube made from XL alloy (Zr–3.5 wt % Sn, 0.7 wt % Mo, 0.7 wt % Nb) and clad with Zr–2.5 wt % Nb, was irradiated in the NRU reactor as part of a program to develop high strength zirconium alloys. Maximum neutron dose was 3.5×10^{24} n/m^2 (>1 MeV). Strength increases resulting from irradiation were smaller than for other zirconium alloys, and tensile ductility was slightly reduced. Oxidation and hydrogen pickup rates were acceptably low. The tube was very tolerant to severe defects including fatigue-sharpened cracks, and tests showed that the "leak before break" criterion of tube safety is applicable. (auth)

14934 (AED-CONF-74-089-041) ANGLE DEPENDENT MEASUREMENTS OF THE CRITICAL CURRENT IN V_3Ga AFTER LOW TEMPERATURE IRRADIATIONS. Krebs, K. R.; Maier, P.; Seibt, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). 1974. 6p. (In German). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft e.V. of the Arbeitskreis Festkoerperphysik; Freudenstadt, F. R. Germany (1 Apr 1974).

With abstract.

The experimental results of a Helium-bath-irradiation arrangement are reported. The angle dependence of the critical current in a V_3Ga wire is measured before and after an irradiation with 50 MeV deuterons. Annealing effects were also studied. The comparison of the field dependence of the volume pinning force with theoretical models is given. (GE)

14935 (AED-CONF-74-587-049) DISLOCATION LOOP ORIENTATION IN HELIUM ION BOMBARDED NICKEL. Sokursky, Yu. N.; Protsenko, L. N. 1974. 14p. INIS.

From irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

With abstract.

The transmission electron microscopic method was used to study the irradiation induced damage of nickel irradiated by 70 keV He ions to dose of 10^{16} ion/cm^2 and subsequently annealed for five hours at 500°C. The Burgers vector directions and the orientations of about 200 dislocation loops are determined. Dislocation loops are shown to be located in the planes 111 with the Burgers vector ½ a ⟨110⟩ and to be prismatic intrinsic dislocation loops. The distribution of loops in the planes 111 is non-uniform. The majority of loops were located in the planes $(\bar{1}1\bar{1})$ and (111) with the Burgers vectors [101], [110] and $[0\bar{1}1]$. The reason for the non-uniform loop distribution was analyzed, and it is shown that it is due to internal stresses that are induced by the He atom implantation into the lattice. Consideration is given to the state of He atoms implanted into the Ni lattice, a comparison is made of the energies of the formation of flat aggregates consisting of He atoms and vacancies and bubbles; it is shown that a certain less than critical size of bubbles in flat aggregates prove to be more stable. (auth)

14936 (CEA-CONF-2927) OBSERVATION OF MAGNETIC PHASES IN STEELS IRRADIATED BY FAST NEUTRONS. Erler, J.; Faugere, J. L.; Dufayet, J. P.; Marcon, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1974. 5p. (In French). INIS.

From European conference on irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

A slight ferromagnetism was observed in irradiated austenitic steels. Large numbers of fuel pins from the reactor Rapsodie were examined and the results of these observations are given. (FR)

14937 (CEA-CONF-2928) RADIATION-INDUCED CREEP. Effects on the Shrouds. Balloffet, Y.; Blanchard, P.; Huillery, R.; Languille, A.; Dupouy, J. M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul–les–Durance (France). Dept. des Reacteurs a Neutrons Rapides; CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul–les–Durance (France). Dept. de Developpement des Elements Combustibles; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1974. 4p. (In French). INIS.

From European conference on irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

Radiation-induced creep appears at low temperatures where conventional thermal creep is undetectable. This phenomenon is taken into account in the flexion calculations of shrouds. The deformation was computed by means of a program using the method of finite elements. The good agreement between measured and calculated profiles shows that the shrouds are deformed by flexion under the pressure of sodium and that this deformation is indeed due to radiation-induced creep since it disappears above the core zone where pressure and temperature nevertheless are still present. (FR)

14938 (WAPD-TM-1176) FATIGUE CRACK PROPAGATION IN NON-IRRADIATED AND IRRADIATED LOW ALLOY STEELS. Hall, J. F. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). May 1975. Contract AT(36-1)-GEN-14. 44p. Dep. NTIS $5.25.

The fracture mechanics approach to fatigue was used to analyze fatigue crack propagation in two low alloy steels, A302B and A508 Class 2, in both non-irradiated and irradiated conditions. Of the materials investigated, the A302B was a radiation sensitive heat with relatively poor initial toughness properties and the A508 Class 2 was an insensitive heat with relatively high initial toughness. In the non-irradiated condition, no significant differences in crack propagation rates of the two materials were noted over the range of DELTA K values of 35 to 110 ksi root in. After 450°F irradiation, room temperature results from A508 Class 2 and 450°F results from A302B fell on the conservative side of the upperbound of non-irradiated room temperature data for the respective materials. (auth)

14939 EFFECT OF LOW-TEMPERATURE IRRADIATION ON THE PHASE COMPOSITION OF LOW-ALLOYED URANIUM WITH ALUMINUM AND IRON. Bobkov, Yu. V.; Naskidashvili, I. A.; Petrosyan, V. V.; Sokurskii, Yu. N. At. Energ. (USSR); 38: No. 1, 20-22(Jan 1975). (In Russian).

Intra-reactor measurements of the electrical resistance of uranium alloys containing 0.88 at. % Al and 0.21 at. % Fe at –152°C were made. It was observed that the electrical resistance of tempered (heterogeneous) as well as of hardened (homogeneous) alloys increases when irradiated by a $5 \cdot 10^{17}$/cm^2 integrated flux of thermal neutrons. The more significant increase, observed for tempered alloys, is associated with the dissolution of finely divided (~0.06 to 0.07μ) U Al_2 and U_6Fe. As a result of this process for doses of 1×10^{18} n/cm^2 heterogeneous alloys pass over to the homogeneous state. (auth)

14940 TEMPERATURE DEPENDENCE OF TOTAL FREE ENERGY OF ACTIVATION FOR DISLOCATION MOTION. II. Copper Crystals after Irradiation With Nearly Mono-Energetic Neutrons. Kamada, K.; Yoshizawa, I.; Naramoto, H. (Japan Atomic Energy Research Inst., Tokai). Phys. Status Solidi A.; 29: No. 2, 545-549(16 Jun 1975).

A test is made for the presence of a spectrum in the strength of obstacle for dislocation motion by calculating the total free energy of activation, ΔG_0, from experimentally obtained activation parameters, after nearly mono-energetic neutron irradiation on copper single crystals. Its temperature dependence was found to be exactly the same with shear modulus in the range from room temperature down to 4.2°K, demonstrating the absence of the spectrum. The same analysis was applied to the data of irradiation-hardening due to Koppenaal and Arsenault, and therefrom the presence of the spectrum was concluded, contrary to the conclusion of the original authors. The analysis was also applied to the data of Diehl et al., concluding the spectrum from their not-corrected data. Their corrected data, on the other hand, gave unreasonable results. (auth)

14941 RADIATION-INDUCED TRANSFORMATION OF FRENKEL PAIRS IN PLATINUM. Jung, P. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi A.; 29: No. 2, 381-386(16 Jun 1975).

In polycrystalline platinum irradiated with 3-MeV electrons to defect concentrations up to about 1.5×10^{-4}, the cross sections for transformation of Frenkel defects by subthreshold irradiation is determined. It is found that after a subthreshold impact a I_C-defect has a higher cross section for transformation to a I_A-defect than for recombination with its vacancy, while for I_B-defects the recombination process is strongly perferred. (auth)

14942 GRAIN BOUNDARY VOID DENUDED ZONE IN IRRADIATED METALS. Konobeev, Yu. V.; Subbotin, A. V.; Bykov, V. N.; Tscherbak, V. I. (Inst. of Physics and Power Engineering, Obninsk, USSR). Phys. Status Solidi A.; 29: No. 2, K121-K124 (16 Jun 1975).

An explanation of the grain boundary void denuded zone is offered, and a comparison with experimental data for oKh16N15M3B stainless steel irradiated in BR-5 and BOR-60 is made. (DLC)

14943 ISOTHERMAL DIFFUSION AND TRAPPING OF HELIUM IN A SILVER-LITHIUM-ALLOY AFTER NEUTRON IRRADIATION. Gaus, H.; Migge, H.; Mirus, K. D. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kernchemie und Reaktor). Z. Naturforsch., A; 29: No. 12, 1742-1749(Dec 1974).

5 figs.; 2 tabs.; 25 refs. With app.

The release of helium from a neutron-irradiated Ag–9.6 at.% Li alloy is measured in the range between 510 and 784°C. Analytical expressions are developed taking into account a recoil modified concentration profile in a surface layer. The isothermal kinetics can be described to some extent with two parameters, the effective diffusion coefficient p^2D and the absorption coefficient μ of helium in traps. From foil-experiments the untrapped fraction p of gas after irradiation is found to be $0.2 \leq p \leq 1$ for a helium concentration of 1.1×10^{-5} at.%. The activation energy of diffusion is found to be 1.7 eV, which indicates a vacancy mechanism. The absorption coefficient μ is of the order of some 10^{-4} [sec^{-1}] and nearly independent of temperature. It is discussed whether the diffusion to the traps or the capture process itself with a negative activation entropy is rate determining. The method seems to be applicable to incomplete degassing of other gas-metal-systems described in the literature. (auth)

14944 MOESSBAUER SPECTRUM OF ^{57}Fe AND ^{119}Sn ASSOCIATED WITH LATTICE DEFECTS IN ALUMINIUM. Kato, M.; Ishida, Y.; Sassa, K.; Umeyama, S.; Mori, M. (Tokyo Univ. (Japan). Inst. of Industrial Science). J. Phys. (Paris), Colloq.; No. 6, 309-313(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The contrasting behavior of iron and tin atoms in quenched, splat-cooled, ion-implanted, or electron-irradiated aluminium alloys were investigated by Moessbauer spectroscopy. In quenched or electron irradiated alloys the interaction of ^{119}Sn with vacancy was detected. Such an interaction was absent with ^{57}Fe. Upon subsequent aging of the alloys various solute rich metastable phases occurred. The stability of the metastable phases in Al-Fe alloy was remarkable and the equilibrium phase grew only at above 400 deg C. (FR)

14945 MOESSBAUER SPECTROSCOPY STUDY OF AGING AND FAST NEUTRON IRRADIATION EFFECTS IN A COPPER-RICH Cu Fe ALLOY. Gould, T. H. Jr.; Vincent, D. H. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). J. Phys. (Paris), Colloq.; No. 6, 315-319(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Moessbauer spectroscopy, supplemented by resistivity measurements, was used to follow the effects of thermal aging and fast neutron irradiation on precipitation processes in a Cu–0.6 at.% Fe alloy. The characterization of spectra of solution annealed and aged alloy samples provides background for interpretation of the complex effects occurring in irradiated alloys. Both irradiation-induced aging and dissolution effects were observed as a function of pre-irradiation heat treatment. In asquenched alloys, fast neutrons cause the formation of very small Fe clusters (<12 atoms). In aged alloys, fast neutron induced displacement spikes disperse Fe atoms existing in clusters and precipitates. The dissolution effects are dependent upon the stage of aging or initial Fe cluster size. (FR)

14946 RADIATION DAMAGE AND STRUCTURAL LATTICE DEFECTS. Vogl, G. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). J. Phys. (Paris), Colloq.; No. 6, 165-180(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Influences of structural lattice defects mainly in metals on Moessbauer studies and the information about these defects available from Moessbauer studies are considered. A short review of present knowledge on the production of defects in collision processes of highly energetic particles (external and internal implantation) and in nuclear reactions is given. Defect migration leading to defect reactions and annealing in on-line experiments and in experiments involving long radioactive half-life is reviewed as well. After a comparison of different methods of studying structural lattice defects, the particular information uniquely available from microscopic methods as the Moessbauer effect and related methods is discussed. In the second part of the paper the mutual influence of defects and Moessbauer studies is demonstrated in a survey of defect relevant Moessbauer experiments. The examples can be divided into two groups: (1) Correlated damage; and (2) Uncorrelated damage followed by trapping of the defects at Moessbauer impurities. Comments concerning the results of various experiments are presented. Finally a recent experiment is discussed in greater length. In this experiment $^{57}Co(^{57}Fe)$ impurities in aluminum trap interstitials produced by low-temperature irradiation in aluminum during the interstitials migration, thus permitting the microscopic investigation of the interstitials with the $^{57}Co(^{57}Fe)$ atoms as microprobes. (FR)

14947 EFFECT OF BOMBARDMENT BY HELIUM IONS ON CRITICAL CURRENTS OF THIN INDIUM FILMS. Fogel, N. Ya.; Moshenskii, A. A.; Titchenko, L. P.; Peregon, T. I.; Fogel, Ya. M.; Dmitrenko, I. M. (AN Ukrainskoj SSR, Kharkov. Fiziko–Tekhnicheskij Inst. Nizkikh Temperatur). Phys. Lett., A; 53: No. 1, 52-54(19 May 1975).

The critical currents of indium films irradiated by helium ions were measured. An effect of irradiation on characteristics of the critical current in a perpendicular field was stated. This effect is due to the change of the degree of a disorder in a substance of the irradiated film. (auth)

14948 NATURE OF INTERSTITIALS IN SILICON AND GERMANIUM. Frank, W. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 23-43 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors, Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Aiming at an increase of the knowledge about self-interstitials in semiconductors, a large body of experimental data (self- and impurity diffusion, quenching, radiation damage, ion implantation) on silicon and germanium are critically reviewed. Seemingly unrelated results can be reconciled in terms of a model which assumes the properties of interstitials, such as geometrical configuration and migration energy, to depend on the charge state and hence on the location of the Fermi level. Whereas for germanium the assignment of charge states to self-interstitials migrating at various temperatures remains tentative, in the case of silicon the situation is quite satisfactory. It has been possible to identify both the donor and acceptor level of Si self-interstitials predicted by Blount's model. Previously suggested values of the migration energies in different charge states have now also been confirmed. For electrically neutral and for positively charged Si self-interstitials, the geometrical configurations, the activation energies for reorientation, and the distributions of electrical charge have been deduced. For these two defects the existence of a unique coupling between the geometrical configuration and the electrical charge state has been demonstrated. This is a prerequisite for the occurrence of athermal migration according to the Bourgoin mechanism found experimentally for both silicon and germanium. Finally, the geometrical configurations and the activation energies of reorientation or decay of two differently charged boron interstitials in silicon have been established. On this basis a unifying interpretation of various experiments on the lattice location and diffusivity of boron implanted into silicon has been suggested. (72 references)

14949 POINT DEFECTS IN GERMANIUM. Mashovets, T. V.; Emtsev, V. V. (Physico-Technical Inst., Leningrad). pp 103-125 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729.

The creation of point defects in Ge has been considered. A set of kinetic equations for the reactions between vacancies, self-interstitials, and group V impurities have been written and solved. The kinetics of variation of defect concentrations in gamma-irradiated Ge were analysed and compared with experimental results. This method provides a means for constructing a model for defect formation in n-Ge under gamma-irradiation (prior to and after n → p conversion). Besides, the proposed model gives insight into processes of defect annealing and has supplied an explanation for defect formation in Ge with a high silicon content. A new mechanism of charge carrier scattering due to radiation-induced elastic strain has been proposed and discussed. (50 references) (auth)

14950 MIGRATION OF DIVACANCY-LIKE DEFECTS IN GERMANIUM BOMBARDED WITH ELECTRONS OF 1.5 MeV AT 77 K. Hirata, M. (Osaka Univ.). pp 164-171 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Germanium single crystals containing P, As, and Sb respectively were irradiated with electrons of 1.5 MeV at 77°K. Isothermal annealing of radiation-induced resistivity was studied in detail

at a number of annealing temperatures. The recovery stage which has been named as III_n^A was observed at around room temperature. In order to understand the experimental facts that the number of III_n^A defects introduced by radiation is approximately proportional to the square of electron flux and the migration energy 0.75 eV is independent of the species of group V impurity, the divacancy model has been proposed as the most prospective candidate for III_n^A stage. In isothermal annealing of this stage, it was found that the apparent number of defects is temperature dependent. The physics of this phenomenon cannot be understood simply. In order to give some physical meaning to this phenomenon, an annealing model is proposed; in this model one type of defect is assumed to be annihilated by two annihilation processes which occur nearly simultaneously. One of the processes can be observed by measuring electric conductivity, but the other is assumed to be unobservable. It is further assumed that these processes have different activation energies. (auth)

14951 ELECTRONIC ABSORPTION NEAR THE BAND EDGE IN NEUTRON-IRRADIATED GERMANIUM. Newman, R. C.; Totterdell, D. H. J. (Univ. of Reading, Eng.). pp 172-177 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

n^0 irradiation of Ge at room temperature produces defects giving rise to near edge absorption and the samples become progressively more p-type. Samples initially doped with As or Sb donors ($6 \times 10^{18} cm^{-3}$) show an absorption band at 2.78 μm provided they remain n-type. These and previous observations are discussed in relation to the possible existence of divacancies in Ge. (auth)

14952 LOW-TEMPERATURE ELECTRON IRRADIATION AND ANNEALING OF N-TYPE GERMANIUM. Lehar, A. F.; Whitehouse, J. E. (Univ. of Reading, Eng.). pp 198-205 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The rate of damage production at low temperature in n-type germanium has been found to be dramatically reduced in those samples which also contain appreciable amounts of compensating group III impurity. It would therefore appear that group III impurities actively assist the mutual annihilation of damage products during irradiation. The extreme case of this action occurs in p-type germanium which is virtually immune to damage at low temperature. However, the damage rate in compensated material is not zero indicating that the group V impurities also compete for damage products and that these survive by being trapped. Measurements have also been made of the annealing at 65°K using a series of high-resistance irradiated samples and they underline the fact that the annealing adheres to 65°K in such experiments for a very wide range of defect concentration (five orders of magnitude). This feature of the annealing, usually taken to indicate first order kinetics, may be reconciled to the behaviour during isothermal annealing in a two-stage model in which ionization is the precursor to diffusion and recombination of defects. A complete numerical solution of the rate equations for this situation is given. (auth)

14953 ANNEALING OF THE E_c: 0.2 eV DEFECT IN N-TYPE GERMANIUM. Fukuoka, N.; Saito, H.; Tatsumi, Y. (Osaka Univ.). pp 206-211 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Annealing of the $E_c - 0.2$ eV level in irradiated germanium was studied through electrical measurements in the temperature range 280-380°K. It was found that the level is annealed in two stages, for convenience called first and second stages. The first stage is observed only for samples containing group V impurities. The defect annealed in this stage is considered to be a complex of a group V impurity and a vacancy. The second stage is observed in all n-type samples regardless of the impurity. One of the ways to understand the experimental results is to assume that the defect is a divacancy. (auth)

14954 ENTROPY OF NEUTRAL AND IONIZED VACANCIES IN Si AND Ge. Van Vechten, J. A. (Bell Labs., Murray Hill, NJ). pp 212-220 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Both quenching and atomic diffusion experiments indicate that the dominant native defect in high-temperature Si and Ge has an entropy of formation of about 5 k. This is substantially larger than the expected value for single neutral vacancies. $S(V^x) \approx k \ln 3$, for which the three-foid degenerate Jahn–Teller distortion should be the most important term. Various hypotheses that the dominant defect at high temperatures is some complex of multiple vacancies and/or interstitials can generally be discredited by consideration of the law of mass action. This situation caused Seeger to suggest that these native defects were not simple vacancies but 'extended' vacancies or interstitials. Here it is shown that the entropy of ionization of a single vacancy, $\Delta S_f(V^+)$, $\Delta S_f(V^-)$ or $\Delta S_f(V^{-2})$, is closely approximated by the entropy of the forbidden band gap, $\Delta S_{cv} = -\partial \Delta E_{cv}/\partial T$. The values of $\Delta S_{cv}(T)$ are known from experiment and reach values of 4 to 8 k above the Debye temperature. The reason that ΔS_{cv} is so much larger here than in close-packed structures is discussed. Adopting these values one may account for both the quenching and the diffusion results with the equilibrium distribution of single vacancies in their various ionization states. Thus, the vacancies are 'extended' in the sense that they are ionized and interact with lattice modes as far as several lattice constants away through the Coulomb interaction. (auth)

14955 DEFECT TRANSFORMATIONS IN N-TYPE GERMANIUM IRRADIATED WITH ELECTRONS AT 140 K. Jaworowski, A. (Univ. of Warsaw); Rzewuski, H. pp 221-226 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 1974). See CONF-740729-.

The annealing processes in As- and Sb-doped germanium irradiated with electrons of different energy at 140°K revealed a new defect transformation stage centered at 230°K with carrier concentration recovery and Hall mobility reverse recovery, which did not depend on the impurity concentration and the type of doping. From the energy dependence of defect transformation rate for the 230°K stage a threshold energy of about 0.7 MeV was evaluated. From the results obtained, conclusions were drawn that the defects $(V^{2-}Sb_s^0)^{2-}$ and $(V^{2-}V^{2-}I^+)^{3-}$ are created with a relative concentration depending on the bombardment electron energy. It is suggested that the main transformation process occurring at 230°K consists in dissociation of $(V^{2-}V^{2-}I^+)^{3-}$ into $I^+ + V_2^{4-}$ influencing the subsequent transformation processes at 330°K. A tentative model was proposed giving an account of the defects induced in n-type germanium irradiated by electrons with different energy at 140°K and their temperature transformations at 230 and 330°K. (auth)

14956 SUBTHRESHOLD DEFECTS IN p-InSb. Abdullaev, A.; Lang, I. G.; Mashovets, T. V.; Vitovskii, N. A. (Physico–Technical Inst., Leningrad). pp 346-352 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

A new phenomenon, the decrease in the concentration of the electrically active impurities in p-InSb under x-ray irradiation at 77°K, was observed. A possible mechanism of the effect is proposed. A theoretical estimation was made for the cross section of the defect creation process. (auth)

14957 DIFFERENCES IN DEFECT PRODUCTION AND ANNEALING PROCESSES IN BORON- AND CARBON-IRRADIATED GERMANIUM. MacDonald, P. J.; Palmer, D. (Univ. of Sussex, Eng.). pp 504-512 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Samples of n-type germanium irradiated with non-channelled 60-keV $^{11}B^+$ and $^{12}C^+$ ions at room temperature to doses of 10^{15} ions/cm^2 at several dose rates were compared by measurements of electrical properties and of lattice disorder concentrations (using the proton channelling/back-scattering method) before and after successive isochronal thermal annealing treatments to 550°C. It was found that both the boron- and carbon-irradiated layers were p-type but that, whereas the sheet resistivity of the boron-irradiated germanium was about 10^2 Ω/□ and changed rather little with annealing, that of the carbon-irradiated germanium was initially about 10^3 Ω/□ and decreased considerably in a reduction stage centered at approximately 300°C. Considerably less lattice disorder was observed for boron irradiations than for carbon irradiations at similar dose rates, and although the disorder seen in the boron-irradiated germanium annealed completely in a stage centered at 150°C, that in the carbon-irradiated material was removed in two stages, at about 150 and 300°C respectively. Dose-rate effects on disorder concentrations were found for both kinds of irradiation. It is suggested that the p-type characters of the layers produced by boron and carbon irradiations are due to electrically active boron atoms and to lattice defects respectively, and that the disorder present in boron-irradiated germanium has little effect on hole mobility. It seems likely that much more de-

fect annealing occurs during irradiation with boron than with carbon, perhaps due to slight differences in defect distributions or to Fermi-level-dependent defect mobilities, and that the absence in boron-irradiated germanium of the defects (presumably more complex) that anneal at the higher temperature is a consequence of this. (auth)

Other Materials

Refer also to abstracts 13846, 13849, 13850, 13871, 14769, 14783, 14875, 14899, 14948, 14954, 16243, 16246, 16383, 16429, and 16496.

14958 (AFML-TR-67-381) RELATIONSHIPS BETWEEN RESIN FRACTURE AND COMPOSITE PROPERTIES. McGarry, F. J.; Willner, A. M.; Sultan, J. N. (Air Force Materials Lab., Wright-Patterson AFB, Ohio (USA)). Dec 1967. 87p. Dep. NTIS $7.50.

At room temperature, the work required to propagate a crack through brittle, crosslinked epoxy resin (bisphenol A-epichlorohydrin type) is approximately $5-9 \times 10^4$ ergs per square centimeter of fracture surface produced. If only C–C bond breakage were involved in the fracture process, the surface energy of the material would be approximately 500 ergs/cm^2. The discrepancy between these values is caused by localized cold drawing and plastic flow in the material adjacent to the fracture surfaces. This discrepancy can be increased, and the material rendered more crack resistant, by suspending fine particles of elastomer throughout the cured epoxy matrix; improvements to 10^6 ergs/cm^2 have been achieved. The particles increase the amount and the extent of the cold drawing which takes place in the glassy resin phase without degrading the other mechanical properties of the crosslinked epoxy. Low molecular weight ($\overline{M}_N$ = 3300, 4000 or 5800) butadiene-acrylonitrile copolymers (80/20 ratio, approximately) with terminal carboxyl groups have proved to be effective toughening in concentrations up to 10%. Soluble in the liquid epoxy, the elastomer can be precipitated as particles over a size range of 200 to 12,000 Å. When the average diameter of the particles is smaller than 1000Å, when adhesion between particles and matrix is inadequate, or when the elastomer remains in solid solution in the crosslinked epoxy, no toughening occurs. The particle size depends upon the initial molecular weight of the elastomer, the nature and concentration of the epoxy crosslinking agent and the temperature at which the mixture is polymerized. With a fixed content of precipitated elastomer, as the particle size increases the crack propagation resistance also increases to a maximum. (auth)

14959 (CEA-CONF-2977) CHANNELING INVESTIGATION OF PHOSPHORUS IMPLANTATIONS IN SILICON: DEFECT EVOLUTION AND PHOSPHORUS ION LOCALIZATION AS A FUNCTION OF ANNEALING. Guivarc'h, A.; Danielou, R.; Ligeon, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1974. 30p. (In French). INIS.

From meeting on particle channeling; Saclay, France (27 May 1974).

Silicon samples implanted with 30 keV phosphorus ions at doses of 3.10^{15}, 10^{16}, and 3.10^{16} ^{31}P/cm^2 were studied as a function of annealing temperature (650 deg C and 850 deg C). Defects were studied by the collimated 1.5 MeV He^+ back-scattering method and the 1892 keV resonance of the $^{31}P(p, \alpha)^{28}Si$ reaction was used to localize the phosphorus ions. The increased electrical activity between 650 deg and 850 deg may be explained by a passage of ^{31}P ions from the interstitial to the substitutional position for doses approximately $\leq 3.10^{15}$ ^{31}P/cm^2; for higher doses it seems to be due to the disappearance of electrically active defects which, after annealing at 650 deg C, act as drifting centers. (FR)

14960 (CEA-CONF-2979) PARTICLE CHANNELING IN ZINC TELLURIDE. Application to the Localization of Implanted Boron. Bontemps, A.; Fontenille, J.; Ligeon, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1974. 24p. (In French). INIS.

From meeting on particle channeling; Saclay, France (27 May 1974).

40KeV boron ions were implanted in ZnTe at 15 deg from the ⟨110⟩ axis and at 77 deg K temperature. The boron was examined by means of the nuclear reaction $^{11}B(p, \alpha)\alpha\alpha$ and the backscattered proton and α particle spectra were observed simultaneously. A digital simulation program was used to study the influence of the impurity position (Zn site or Te site) on the backscattering and nuclear reaction yields. (FR)

14961 (IPF-74-10) MOMENTS METHOD INVESTIGATIONS INTO THE INFLUENCE OF A HIGH DIFFUSION RATE ON TRANSPORTATION IN GAS MIXTURES. Schwoerer, K. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1974. 156p. (In German). INIS.

The collision terms determined for a stationary, spatially homogeneous two-component mixture are used for an investigation into the influence of the diffusion rate on the frictional force and the temperature difference between the two gas components as well as on the pressure anisotropy and the rate of heat flow-flux of each component in same basic interaction laws in different approximations. The values of pressure anisotropy and heat flow serve to check the validity of an assumption of hardly affected Maxwell distributions of the individual gas components in the respective frame of reference. (GE)

14962 (UCID-16815) 1,06 mu m REFLECTIVITY MEASUREMENTS OF METAL OPTICS. Saito, T. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jun 1975. Contract W-7405-Eng-48. 13p. Dep. NTIS $4.00.

The equipment and technique for the measurement of 1.06 mu m reflectivity of diamond turned, diamond turned/polished, and polished metal mirrors is presented. From an analysis of repeatability and systematic errors I conclude the precision of the measurements is 0.003 and the accuracy is 0.005. Diamond turned mirrors compete well with the best 1 mu m reflectivity values reported and are superior to polished surfaces studied in this work. (auth)

14963 (WANL-TME-956) PROPERTIES OF ATJ GRAPHITE. Kachur, V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Nov 1964. 75p. Dep. NTIS $6.75.

As an aid to engineers and designers, selected physical and mechanical properties of ATJ molded graphite were investigated for the 9 × 20 × 24-inch stock in connection with its use for NERVA hardware. Graphite density was found to range from about 1.50 to 1.80 g/cc near the mold surfaces, and 1.69 to 1.76 g/cc near the block's center. Both flexure strength and hardness were found to increase with density, while electrical resistivity decreased. In the case of tensile and compressive strength, dependence on density was not evident. Thermal expansion and tensile strength were studied between room temperature and 2800°C (5070°F), while the remaining properties were determined at room temperature only. All properties exhibited considerable scatter, even when measured on specimens of comparable density. (auth)

14964 SURFACE EFFECTS IN SILICON EPITAXIAL-PLANAR TRANSISTORS DURING ELECTRON IRRADIATION. Babikova, Yu. F.; Dement'ev, Yu. S. pp 140-143 of Struktura i svoystva sverkhprovodyashchikh materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Experiments are described on clarification of the influence of surface effects on the kinetic change of the transmission factor of the base of type p-n-p silicon expitaxial-planar transistors in the case of irradiation by electrons at various temperatures. Irradiation by electrons with an energy of 4.5 Mev was conducted in a linear accelerator. On a basis of the results obtained, the following conclusions were made: The surface effects determine the change of the amplifying properties of type p-n-p epitaxial-planar transistors during electron irradiation. At various temperatures of irradiation, the change by dosage of the surface component of the magnitude of the inverse transmission factor has the nature of an exponential function. At lower temperatures of irradiation, the change of the amplification properties of the transistor because of the surface effects is greater than with room temperature irradiation. (Ref. Zh.)

14965 ANNEALING OF EPR, RADIATION CENTERS IN ALKALI TELLURITE GLASSES. Mikhailova, T. G. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 138-140(1975). (In Russian).

Results of an investigation of an isothermal annealing of radiation alpha and beta centers are presented. The alpha centers are believed to be oxygen radicals TeO_3^-, and the beta centers are TeO_4^{3-}. Thermal annealing of these paramagnetic centers in alkali tellurite glasses at the initial stage is satisfactorily described by a reaction which is limited by diffusion. The glasses which were given a Co-60 gamma dose of 2.5×10^5 rads contained 15 to 25% Na_2O, 11% K_2O and 9% Cs_2O with the remainder being TeO_2 (75 to 91%). The diffusion activation energy was found to depend on the composition of the glass. The main factor determining the diffusion activation energy as a function of glass composition was not the microstructure of the defects under study, but the physical-chemical properties of the regions of defect localization. (SJR)

14966 MAGNETIC FIELD EFFECT ON THE LUMINESCENCE FROM GAMMA-IRRADIATED SOLUTIONS OF FLUORENE. Dixon, R. S.; Grady, E. M.; Lopata, V. J.; Sargent, F. P. (Atomic Energy

of Canada, Pinawa, Manitoba). Chem. Phys. Lett.; 30: No. 3, 463–464(1 Feb 1975).

The luminescence from gamma-irradiated solutions of fluorene increases when a magnetic field is applied, in agreement with recent theoretical predictions. The magnitude of the field effect is shown to be solvent dependent due to the changes in the solute ion recombination rates. (auth)

14967 DETERMINATION OF JUNCTION DEPTH IN IMPLANTED SILICON BY PULLED ANODIZATION AND CAPACITANCE-VOLTATE MEASUREMENTS. Balazs, A.; Hermann, L.; Gyulai, J. (Central Research Inst. for Physics, Budapest.) Phys. Status Solidi A.; 29: No. 2, K105-K108(16 Jun 1975).

Implanted (B and P) silicon stripes were anodically oxidized pulling the crystal slowly from the electrolyte. Stripping off the wedge-shaped oxide, the junction can be exposed. Another way to determine the depth is to use this oxide as dielectric in an MOS condenser and perform capacitance-voltage measurements on it. The pulled anodization turned out to be easier to handle and a calibration of depth is more straightforward than, say, for pulled etching. (DLC)

14968 GAS ANALYSIS DURING THE CHEMICAL VAPOR DEPOSITION OF CARBON. Lieberman, M. L.; Noles, G. T. (Sandia Labs., Albuquerque, NM). pp 19-29 of Chemical Vapor Deposition, Wakefield, G. F. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1973).

From fourth international conference on chemical deposition vapor; Boston, Massachusetts, USA (7 Oct 1973). See CONF-731017-.

Gas chromatographic analyses were performed during the chemical vapor deposition of carbon in both isothermal and thermal gradient systems. Such data offer insight into the gas phase processes which occur during deposition and the interrelations which exist between gas composition, deposition rate, and resultant structure of the deposit. The results support a carbon CVD model presented previously. The application of chromatographic analysis to research, development, and full-scale facilities is shown. (auth)

14969 CARRIER CONCENTRATION CHANGES IN TELLURIUM INDUCED BY THERMAL NEUTRON CAPTURE. Kuehnel, A.; Siethoff, H.; Landwehr, G. (Univ., Wuerzburg, Ger.). Phys. Status Solidi A.; 29: No. 2, 387-394(16 Jun 1975).

Tellurium single crystals were irradiated with thermal neutrons in a nuclear reactor. Hall effect and resistivity were measured at 77°K before and after irradiation. The electrical properties of the samples changed appreciably after the neutron exposure. The hole concentration decreased for small neutron doses followed by an increase at higher doses; conversion to n-type tellurium was not observed. The Hall mobility showed a similar behavior. Different processes are discussed which may be responsible for the changes in carrier concentration. A formula is given which describes the observed effects at small neutron doses. (auth)

14970 MODULATION SPECTRUM AND PROFILE OF THE ABSORPTION LINE OF HYPERBOLIC EXCITONS IN INDIUM SELENIDE. Abutalybov, G.I.; Belle, M.L. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Semicond. 8: No. 12, 1559-1562 (June 1975).

The direct and wavelength-modulation methods were used in a study of the middle part of the fundamental absorption band of an InSe single crystal. The observed structure of the absorption spectrum had two special features: The high-energy feature corresponded to interband transitions at a saddle point M_1 and the low-energy feature corresponded to an absorption peak of hyperbolic excitons formed near the saddle point. Measurements carried out at different temperatures indicated that the temperature coefficient was the same for both features. The binding energy of hyperbolic excitons was found to be $\Delta E^1_{ex} = 0.345$ eV. A model of a singular point with three different effective masses was developed for layered III-VI crystals such as InSe, GaSe, and others. (auth)

14971 INFLUENCE OF UNIAXIAL DEFORMATION ON THE CONDUCTIVITY OF COMPENSATED P—TYPE Ge AND ON THE CHANGE IN THE CONDUCTIVITY DUE TO MICROWAVE RADIATION. Vavilov, V.S.; Kazanskii, A.G.; Koshelev, O.G. (M. V. Lomonosov Moscow State University). Sov. Phys.—Semicond. 8: No. 12, 1557-1558 (June 1975).

An investigation was made of the influence of uniaxial compression on the conductivity of compensated p-type Ge and on the change in the conductivity under the influence of microwave radiation ($\lambda \simeq 3$ cm). The investigation was carried out on compensated samples ($K = 0.4$) with an acceptor concentration $N_A = 3 \cdot 10^{15} - 9 \cdot 10^{16}$ cm^{-3} in the temperature range 1.95–4.2°K under pressures up to 6 tonne/cm^2. The measurements were carried out along different crystallographic directions. The conductivity σ was a nonmonotonic function of the pressure F. The conductivity minimum corresponded to 1–2 tonne/cm^2. The compression altered the activation energy of impurity conduction ϵ. The uniaxial pressure influenced also the relative change in the conductivity under the influence of microwave radiation ($\Delta\sigma/\sigma$). The nature of the dependence $(\Delta\sigma/\sigma)(F)$ varied with temperature, impurity concentration, and microwave modulation frequency but was practically independent of the direction of deformation. At 4.2°K, the pressure dependences of $\Delta\sigma/\sigma$ and e were correlated. (auth)

14972 THERMO-EMF DUE TO HEATING OF CARRIERS BY A MICROWAVE ELECTRIC FIELD APPLIED TO A SEMICONDUCTOR COMPOUND InSe. Akhundov, G.A.; Abdinov, A.S.; Kyazym-zade, A.G.; Mekhtiev, N.M. (S. M. Kirov Azerbaidzhan State University, Baku). Sov. Phys.—Semicond. 8: No. 12, 1508-1510 (June 1975).

The thermo-emf due to the heating of carriers by a strong microwave electric field applied to a layered semiconductor InSe was observed and investigated for the first time. The measurements were carried out in the temperature range 77–300°K. It was established that the application of fields of several hundreds of volts per centimenter along the layers produced a thermo-emf U_T due to the heating of carriers. The numerical value of U_T and it dependence on the field intensity varied considerably with temperature. The temperature dependences of the electrical conductivity of the same samples were recorded in different fields. The results obtained and a comparison of the dependences $U_T(E)$ and σ (E) yielded the dominant scattering mechanisms under different conditions. It was established that at $T_0 < 120$°K in fields $E \leq 10^3$ V/cm the influence of repulsive capture centers dominated the carrier lifetime, whereas at $T_0 > 120$°K in fields $E > 10^3$V/cm the mobility changed with rising field due to the scattering of carriers by the acoustic lattice vibrations. Moreover, the dependence $U_T(E)$ was used to determine the mobility and effective temperature of carriers. (auth)

14973 ENERGY DISTRIBUTION OF THERMALLY STIMULATED EXOELECTRONS FROM LiF POWDER. Hayakawa, Y.; Oda, N. (Tokyo Inst. of Tech.). Phys. Status Solidi A.; 29: No. 2, K117-K119(16 Jun 1975).

The charging effect due to irradiation and the exoelectron emission was examined using two LiF powders of differing grain sizes (≤ 3 and 40 μm). Electric field was applied during irradiation with γ rays. The effect was found to be negligibly small for the fine powder. (DLC)

14974 MOESSBAUER STUDY OF PROTON IRRADIATION EFFECTS IN HYDRATED IRON (II): AMMONIUM SULFATE, AND IRON (III) AMMONIUM ALUM. Kopcewicz, M.; Kotlicki, A.; Szefer, M. (Univ., Warsaw). Phys. Status Solidi A.; 29: No. 2, 635-643(16 Jun 1975).

Moessbauer effect measurements were made on proton-irradiated absorbers such as hydrated iron(II) ammonium sulphate (Mohr's salt), and iron(III) ammonium alum as a function of proton energy (in the range from 0.3 to 1.5 MeV) and proton dose. The irradiation leads to successive stages of decomposition of the compounds investigated: in the case of Mohr's salt the compounds observed are $FeSO_4 \cdot 7\ H_2O$, $FeSO_4$, $Fe_2(SO_4)_3$, $Fe_2O(SO_4)$, FeS_2 and finally Fe_3O_4, and in the case of iron(III) ammonium alum these are: $Fe_2(SO_4)_3$ and Fe_2O_3. The location of Fe^{3+} ions in the $FeSO_4$ lattice was observed. From the experimental data obtained, the volume of the chemical decomposition region due to formation of a thermal spike was evaluated. The effects observed were interpreted in terms of the "spike" model. (auth)

14975 EVALUATION OF THE SIZE OF THE SPIKE REGIONS FORMED IN DIELECTRIC IRON COMPOUNDS DUE TO PROTON IRRADIATION. Kopcewicz, M.; Kotlicki, A.; Szefer, M. (Univ., Warsaw). Phys. Status Solidi A.; 29: No. 2, K125-K128(16 Jun 1975).

The thermal spike model is used to make some calculations for dielectric iron compounds. Results are in good agreement with experimental data for iron ammonium sulfate and for $K_4(Fe(CN)_6) \cdot 3H_2O$. (DLC)

14976 PRECIPITATION IN PURE AND INDIUM-DOPED CdTe AS A FUNCTION OF STOICHIOMETRY. Selim, F. A.; Swaminathan, V.; Kroeger, F. A. (Univ. of Southern California, Los Angeles). Phys. Status Solidi A.; 29: No. 2, 465-473(16 Jun 1975).

The Hall effect of nearly pure CdTe and CdTe doped with 1.2×10^{17} and 2×10^{18} In cm^{-3} was measured as a function of the cadmium pressure both at high temperatures where the crystals were in equilibrium with the atmosphere and at room temperature on crystals quenched after the anneal. In the almost pure crystals, a fraction of the electrons resulting from a Cd excess at high temperatures disappear after cooling due to precipitation of the native donors. Transmission electron microscopy shows the presence of Cd precipitates and/or intrinsic dislocation loops, indicating interstitial Cd as the precipitating native donor. For the indium-doped crystals, the properties of quenched crystals depend on the cooling procedure, different results being obtained

for cooling the crystal before the Cd pool establishing the Cd pressure, or vice versa. At high p_{Cd} the difference is attributed to co-precipitation of indium and cadmium as an In–Cd alloy in the former case, but not in the latter. At medium p_{Cd} the difference is due to a difference in the rate of cooling, cadmium vacancies precipitating in one case but not in the other. (6 fig) (auth)

14977 DEFECT CENTERS IN SILICON PRODUCED BY ROOM TEMPERATURE ELECTRON IRRADIATION. III. Hall Coefficient Studies. Natarajan, K.; Heasell, E. L. (Univ. of Waterloo, Ont.). Phys. Status Solidi A.; RR: No. 2, 415-420 (16 Jun 1975).

Results of Hall coefficient and resistivity studies versus temperature on n-type high resistivity, electron-irradiated silicon are presented. When these results are considered in conjunction with parallel studies of photoconductivity and thermally stimulated current measurements made on the same group of samples, it is possible to propose a consistent model for the defect concentration and energy level distribution. Computed electron concentrations, and their variation with temperature are in good agreement with the experimental results. Levels computed from electrical studies are assigned to the neutral state of the divacancy, and to a center tentatively identified as the K-center. (auth)

14978 HIGH FIELD STUDY OF HYPERFINE INTERACTIONS AND COVALENCY EFFECTS IN EUROPIUM-MONOCHALCOGENIDES. Sauer, C.; Koebler, U.; Zinn, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung; Kalvius, G. M. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). J. Phys. (Paris), Colloq.; No. 6, 269-274(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The hyperfine fields and isomer shifts of the 21.6keV transition of ^{151}Eu were studied in external magnetic fields up to 13 T in the ferromagnetic saturated state of the Europium-monochalcogenides. For the antiferromagnetic phase of EuTe the h.f. field is –25.6T and differs by –5.0T from the h.f. field in the ferromagnetic phase due to the transferred field contributions of the Eu-neighbors. The h.f. fields, B_f, in the ferromagnetic state should be compared with the value of $R = g(S + 1)$ which is derived from the Eu^{2+} magnetic moment, $\mu = g\mu_B S$, as determined by magnetization measurements. The values measured in EuO, EuS, EuSe, and EuTe are B1 = –30.5, –33.0, –32.8, –30.6T, and R = 9.72, 9.32, 9.28, 9.69, respectively. For a pure $4f^7$-$^8S_{\frac{7}{2}}$ configuration of the Eu^{2+}-ion the values of B_f and R are expected to be –34.2T and 9.0. The deviations are probably caused by orbital admixtures which are assumed to vary between EuO and EuTe in relation to the location of the 4f-level within the energy bands. (FR)

14979 MOESSBAUER EFFECT STUDIES OF Te COMPOUNDS. Mahmud, Y.; Boolchand, P.; Hanna, S. S.; Triplett, B. B. (Stanford Univ., Calif. (USA). Dept. of Physics). J. Phys. (Paris), Colloq.; No. 6, 227-230(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Isomer shifts (IS) and quadrupole splittings (QS) are reported for a number of Te compounds. When the isomer shifts for Te compounds are plotted against the isomer shifts for similar I compounds a roughly linear plot results for pairs of compounds which are both isoelectronic and isostructural. Pairs which are not isoelectronic but merely have similar chemical character deviate from the linear relation. For these similar compounds it is noted that the Te-X bonds are more ionic than the I-X bonds. An attempt is made for giving this argument more quantitative and a correlation found to exist between the quadrupole splitting and the isomer shift is also found to apply to chemically dissimilar Te compounds. (FR)

14980 MOESSBAUER STUDY OF CUBIC IRON-DOPED $KMgF_3$ IN THE PRESENCE OF A MAGNETIC FIELD. Regnard, J. R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). J. Phys. (Paris), Colloq.; No. 6, 181-183(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Iron-doped $KMgF_3$ single crystals were studied by the Moessbauer technique in the presence of a magnetic field. The quadrupole interaction induced by a 50kOe external field is –0.36 ± 0.03mm/s and +0.65 ± 0.05mm/s when the field is successively oriented parallel to the (100) and (111) directions of the cubic crystal. Using Ham's model, one can deduce that the coupling of the electronic triplet state with the T(2g) modes of vibration is more important than coupling with the E(g) modes. Recent experiments of the same type with the system $CaO:Fe^{2+}$ showed the inverse of the above behavior. (FR)

14981 MOESSBAUER EFFECT OBSERVATION OF DIVALENT GADOLINIUM. Buskes, H. A.; Cashion, J. D. (Monash Univ., Clayton (Australia). Dept. of Physics). J. Phys. (Paris), Colloq.; No. 6, 221-223(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The resonant absorption of the 86.5 keV gamma rays by ^{155}Gd was used to detect divalent gadolinium in CaF_2:Gd. The isomer shift between Gd^{2+} and Gd^{3+} was measured to be $+(0.35 \pm 0.09)$ mm s^{-1} confirming that the electron configuration of Gd^{2+} is $4f^7\,5d^1$. The value of $\Delta\langle r^2\rangle$ for the 86.5 keV transition was deduced to be $-(8.2 \pm 2.1) \times 10^{-3}$ fm^2. The measured splittings for gadolinium in the divalent state were found to be considerably larger than for trivalent gadolinium. (FR)

14982 DRIVE-IN DIFFUSION STUDIES ON ANTIMONY AND GALLIUM IMPLANTED INTO SILICON. Gyulai, J.; Csepregi, L.; Nagy, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)); Mayer, J. W.; Muller, H. (California Inst. of Tech., Pasadena (USA)). Vide; 29: No. 174, 416-418(Nov 1974).

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974).

Results of 80keV antimony and gallium implants into silicon followed by a drive-in diffusion are discussed. For analysis, 2MeV nuclear backscattering and Hall effect with sheet resistivity measurements were used, the latter combined with anodic stripping technique. (FR)

14983 OPTICAL ABSORPTION IN Ge AND Si AFTER PROTON BOMBARDMENT AT 10 K. Stein, H.J. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 46: No. 7, 3211-3212 (July 1975).

The first observation of annealing centered at $\simeq$ 30 K for near-edge absorption in proton-bombarded Ge is reported, and direct production of the 2.4-μm band in Ge and of the 1.7-μm divacancy band in Si is shown to occur for 400-keV proton bombardment at 10 K. Annealing between 10 and 70 K has no effect within experimental uncertainties upon the 2.4-μm band in Ge or upon the proton-induced-defect absorption in Si. (auth)

14984 SPACE-CHARGE-LIMITED CURRENTS IN ELECTRON-IRRADIATED DIELECTRICS. Nunes de Oliveira, L.; Gross, B. (Departamento de Física e Ciência dos Materiais, Instituto de Física e Química de São Carlos, Universidade de São Paulo, 13560-São Carlos, São Paulo, Brasil). J. Appl. Phys. 46: No. 7, 3132-3138 (July 1975).

This paper develops the theory of steady-state currents generated in a dielectric placed between positively or negatively biased electrodes and irradiated with a partially penetrating electron beam. The dielectric is divided into an irradiated region (IR), which extends from the electrode of incidence to the extrapolated range of the beam, and a nonirradiated region (NIR). In the IR the primary beam generates an electron-hole plasma. Its end plane acts as a virtual electrode embedded in the dielectric. Currents are space-charge limited in the NIR and Ohmic in the IR which is characterized by a uniform radiation-induced conductivity. Depending on the polarity of the electrode bias, electrons or holes are drawn from the IR into the NIR. The theory correctly predicts an apparent threshold effect for the onset of steady-state currents: the current amplitudes remain small as long as the electron range is smaller than half the sample thickness, and increase strongly only afterwards. Calculated current curves for different beam energies are in satisfactory agreement with experimental results. The role of the electron beam as a virtual electrode is discussed. (auth)

14985 FERROELASTIC BEHAVIOR OF $Nd_xLa_{1-x}P_5O_{14}$ CRYSTALS. Budin, J.P.; Milatos-Roufos, A.; Duc Chinh, N.; Le Roux, G. (Centre National D'Etudes Des Télécommunications, 92220-Bagneux, France). J. Appl. Phys. 46: No. 7, 2867-2872 (July 1975).

Ferroelastic behavior has been observed in $Nd_xLa_{1-x}P_5O_{14}$ single crystals. In this paper experimental emphasis is on the $x=0.75$ composition. In these crystals, which belong to the monoclinic space group $P2_1/c$-C^5_{2h} at room temperature, twinning is present, and it gives rise to surface deformations. These have been studied by an optical method. The domains have also been studied by observation between crossed polarizers and by x-ray diffraction techniques. The ferroelastic nature of the twinning is demonstrated by the ability to alter the domain pattern by a small shear stress of suitable orientation. The domain structure vanishes at 141 ± 2 °C. Above this temperature the crystals are most likely orthorhombic with space group *Pncm*-D^7_{2h} (conventional setting *Pmna*). The characteristic ferroelastic parameter, the spontaneous strain, is a pure shear in the (010) plane, amounting to 4×10^{-3} at 20 °C. The temperature dependence of this strain indicates a second-order transition, in agreement with differential thermal analysis results. Besides the Nd_xLa_{1-x} ultraphosphates in the range $x=0$ to $x=1$, many other crystals such as the rare earth (La through Tb) and Bi ultraphosphates can be expected to behave in a similar manner. (auth)

14986 POLYATOMIC-ION IMPLANATION DAMAGE IN SILICON. Davies, J.A.; Foti, G.; Howe, L.M.; Mitchell, J.B.; Winterbon, K.B. (Chalk River Nuclear Laboratories, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada). Phys. Rev. Lett. 34: No. 23, 1441-1444 (9 June 1975).

We have investigated the number, N_d, of displaced lattice atoms in room-temperature implantation in Si of polyatomic-carbon-ion beams (C_n^+ and $C_{n-x}O_x^+$) for several values of n, using the backscattering-channeling-effect technique. For each ion species the same energy (8.8 keV) per carbon and the same atomic fluence and flux were used. N_d increases rapidly with increasing n, indicating that the deposited-energy density within the collision cascade is a key factor in determining how much damage is created and retained. (auth)

14987 ISOTOPE EFFECT IN THE RESISTIVITY OF SCANDIUM HYDRIDE. Fisk, Z.; Johnston, D. C. (California Univ., La Jolla, San Diego (USA). Inst. of Pure and Applied Physical Sciences). Phys. Lett., A; 53: No. 1, 39-40(19 May 1975).

The temperature dependent resistivities of ScH_2 and ScD_2 differ by an Einstein term with $\theta_E = 1600$ K and $\theta_E/\sqrt{2}$, respectively. (auth)

14988 SOME SECOND-PHASE STRUCTURES IN GALLIUM ARSENIDE ANNEALED AFTER IMPLANTATION WITH ZINC. Benson, R.B. Jr.; Littlejohn, M.A.; Pao, P.S.; Sarin, H.K. (North Carolina State University, Raleigh, North Carolina 27607). Appl. Phys. Lett. 27: No. 2, 69-71 (15 July 1975).

After GaAs was implanted with 10^{15}/cm^2 60-keV Zn ions at ambient temperature, annealing with a rf-sputtered SiO_2 passivating layer resulted in the formation of the second-phase structures $ZnGa_2O_4$ at 800 °C and primarily Zn_3As_2 at 600 °C. Possible relationships between the second-phase structures and the electrical properties of the ion-implanted annealed regions are discussed. (auth)

14989 MEASUREMENT OF LOCAL MAGNETIC AND ELECTRIC FIELDS IN RARE EARTH ORTHOVANADATES. Pletnev, R.N.; Lisson, V.N.; Chirkov, A.K.; Fotiev, A.A. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.—Solid State 16: No. 12, 2397-2397 (June 1975).

The nuclear magnetic resonance spectra of V^{51} in five rare earth orthovanadates has been studied. The materials investigated were $TbVO_4$, $DyVO_4$, $HoVO_4$, $ErVO_4$, and $TmVO_4$. Results are given for the values of the quadrupole coupling constants and the components of the anisotropic shift tenson.(AIP) (auth)

14990 PARAMAGNETIC HOLELIKE DEFECT IN IRRADIATED CALCIUM HYDROXYAPATITE SINGLE CRYSTALS. Mengeot, M.; Bartram, R.H.; Gilliam, O.R. (Department of Physics and Institute of Materials Science, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. B 11: No. 11, 4110-4124 (1 June 1975).

Electron-spin-resonance studies have been conducted at 9.2 and 23.1 GHz on synthetic calcium hydroxyapatite single crystals after exposure to ionizing radiation. The major paramagnetic defect is a spin-1/2 holelike center which is observable at 92 K but not at room temperature. It exhibits hyperfine interaction with a hydrogen nucleus as proved by deuterium substitution. The center is believed to be an O^- ion which results from removal of hydrogen from an OH^- ion. The hyperfine interaction is with the hydrogen of an adjacent OH^- ion. In first approximation the defect is axially symmetric with respect to the pseudohexagonal c axis; the spin-Hamiltonian parameters are $g_\parallel = 2.0018 \pm 0.0002$, $g_\perp = 2.0683 \pm 0.0002$, $A_\parallel = -5.6 \pm 0.2$ G, and $A_\perp = +5.9 \pm 0.2$ G. "Forbidden" transitions $\Delta M_I = \pm 1$ cause complex unresolved spectra for orientations intermediate between $\vec{H} \parallel \vec{c}$ and $\vec{H} \perp \vec{c}$. To fit computer-simulated spectra to the experimental spectra, it was necessary to postulate that the hyperfine interaction is with an OH^- ion tilted 6° or 7° relative to $\vec{c}$ in six geometrically inequivalent directions. The isotropic hyperfine interaction was calculated using an approximate wave function constructed by a linear combination of orbitals from the O^- and OH^- ions. This establishes that the hole is strongly localized on the O^- and gives the absolute signs of the hyperfine components. (auth)

14991 DEVELOPMENT OF HIGH VOLTAGES IN POTASSIUM DIHYDROGEN PHOSPHATE IRRADIATED BY γ RAYS. Yockey, H.P.; Aseltine, C.L. (U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland 21005). Phys. Rev. B 11: No. 11, 4373-4382 (1 June 1975).

The ferroelectrics Rochelle salt and guanidinium sulfate hexahydrate, when irradiated by γ rays, were found by Gilliland and Yockey to exhibit intense scintillations during a temperature ramp. Yockey found the same effect in potassium dihydrogen phosphate and triglycine sulfate. Robertson and Baily, Schmidt and Peterson, and Zerem and Halperin confirmed these results and identified the spectrum as that of the second positive system of N_2 or the first negative system of N_2^+. These bands are excited by electric discharges in the ambient gas. We have improved the time resolution of the scintillation by use of an RCA C31024 and found a rise time of about 1.5 nsec. Nine lines have been found which are all identified only with the second positive system of N_2. The 391.4-nm line of N_2^+ is not found and therefore the electron energy spectrum does not extend much above 19 eV. A few of the light pulses are partially polarized and therefore come from internal breakdown inside the crystal. Voltage differences of about 13 kV must exist across the crystal or to ground. The scintillations are not seen if the crystal is not in the ferroelectric phase when irradiated. The model of Zerem and Halperin is replaced by the suggestion that real charge liberated in the crystal by the absorbed dose, is trapped at domain boundaries and is freed during the temperature ramp. The effect is not associated with thermoluminescence as was formerly believed. Some crystals are not active but are activated by exposure overnight to 8000-psi N_2 at 50°C. (auth)

14992 RADIATSIONNYE EFFEKTY V KREMNII. (Radiation Effects in Silicon). Konozenko, I. D.; Semeniuk, A. K.; Khivrich, V. I. Kiev; Izdatel'stvo Naukova Dumka (1974). 200p.

Results of a large number of investigations on the effects of radiation on silicon and germanium are summarized. Basic concepts on the creation of defects in crystals are elucidated, and models of identified radiation defects are analyzed. The effects of radiation defects on the physical properties of silicon single crystals are examined. Results of studies of bulk-gradient phenomena and kinetic effects in silicon and germanium bombarded by 60-Co gamma photons and accelerated electrons and neutrons are evaluated. (auth)

14993 LATTICE DEFECTS IN SEMICONDUCTORS, 1974. International Conference Held in Freiburg. i. B., Germany, July 22—25, 1974. Institute of Physics Conference Series Number 23. Bristol, Eng.; Institute of Physics (1975). 609p. (CONF-740729). $50.00.

Sixty-nine papers and 5 abstracts are arranged under the following headings: invited papers, Si and Ge, Te and Te compounds, diamond, compound semiconductors, dislocations, ion implantation, materials problems, diffusion, and new techniques. Separate abstracts were prepared for 37 of the papers. (DLC)

For abstracts of individual papers see: 14791, 14948—14957, and 14994—15019.

14994 EPR STUDIES OF THE LATTICE VACANCY AND LOW-TEMPERATURE DAMAGE PROCESSES IN SILICON. Watkins, G. D. (General Electric Corporate Research and Development, Schenectady, NY). pp 1-22 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

EPR studies of silicon irradiated at 20.4 and 4.2°K by 1.5- and 46-MeV electrons are described. In 46-MeV irradiations the dominant defects formed appear to be divacancies and other multiple defect aggregates which liberate vacancies throughout the anneal to room temperature as they reorder, recombine, etc. For 1.5-MeV irradiations, group III atoms play a vital role in p- and n-type materials in trapping interstitials and stabilizing damage. Carbon and oxygen are not effective interstitial traps at these temperatures. Evidence of limited vacancy migration during irradiation is also cited. Two distinct excited configurations of vacancy-oxygen pairs are identified as precursors to A-center formation in n-type silicon. The kinetics for their conversion to A-centers depends strongly upon the Fermi level as does the isolated vacancy migration energy which is measured to be 0.18 ± 0.02 eV for the V^{2-} charge state. The vacancy has four charge states, V^+, V^0, V^-, and V^{2-}. Kinetics for hole release from V^+ reveals an activation barrier of 0.057 eV. The concentration of V^+ at 20.4°K in boron-doped material indicates the corresponding donor level even closer to the band edge, approximately $E_v + 0.039$ eV. Jahn—Teller energies for V^0, V^+, and V^- are estimated from stress-alignment studies and confirmed to be large. Kinetics studies for reorientation from one Jahn—Teller distortion to another are also described for each charge state. (auth)

14995 LATTICE DEFECTS IN ION-IMPLANTED SEMICONDUCTORS. Kimerling, L. C.; Poate, J. M. (Bell Labs., Murray Hill, NJ). pp 126-148 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

This paper summarizes the current status of ion implantation damage research in semiconductors. We have attempted to review the recent interesting measurements and theories. The damage process is traced from the production mechanism to the structural and electrical properties of the defects and their annealing characteristics. Defect—impurity interactions and lattice site location of the implanted ion are discussed. New areas of

research such as enhanced diffusion, gettering and mixing phenomena are discussed. (90 references) (auth)

14996 IONIZATION EFFECTS ON IMPURITY AND DEFECT MIGRATION IN SEMICONDUCTORS. Bourgoin, J. C. (Groupe de Physique des Solides de l'ENS, Paris); Corbett, J. W. pp 149-163 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The principle and the phenomenology of the ionization-enhanced diffusion (IED) mechanisms, classified as the normal IED mechanism, the Bourgoin mechanism and the energy release mechanism, are reviewed. Justification for the existence of these mechanisms is given. Applications of the mechanisms to the cases of point defects under irradiation and of impurities under sub-threshold irradiation are discussed. (77 references) (auth)

14997 INTERACTION OF THE PRIMARY RADIATION DEFECTS WITH IMPURITIES IN p-TYPE SILICON AT 80 TO 200 K. Vavilov, V. S. (Lebedev Inst. of Physics, Moscow); Kolodin, L. G.; Makashev, B. N.; Nussupov, K. H.; Spitsyn, A. V.; Takibaev, Z. S.; Tnishtikbaev, K. B. pp 185-189 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The influence of the acceptor type (Al, B) and concentration and the oxygen content in p-type Si on the defects build-up under irradiation with 2-MeV electrons at 80°K and also on their annealing in the range 150-200°K was studied. It was observed that the defects introduced by 80°K irradiation act as much more effective scattering centers when Si was doped with Al than in the case of Si with B impurity. To explain this fact it is suggested that the prevailing kind of silicon interstitial–acceptor interaction depends on the acceptor atom size. Accordingly, it is supposed that the replacement mechanism dominates only in Al-doped crystals, in which case Al_i^{3+} centres appear after 80°K irradiation, while the neutral complexes ($B_s^- Si_i^+$) are mainly introduced in B-doped samples. It was found also that the introduction rate of the acceptor–vacancy complex (the $E_v + 0.45$ eV level centre) depends on the impurity atom size. (auth)

14998 IMPLICATIONS OF CLUSTER MODEL OF NEUTRON EFFECTS IN SILICON. van Lint, V. A. J.; Leadon, R. E. (Intelcom Rad. Tech., San Diego, CA). pp 227-232 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The types and amount of damage created in silicon by radiation depend on the radiating particle and its energy. Low-energy electrons create primarily point defects, while neutrons produce localized clusters of displaced atoms. The damage from protons and high-energy electrons is partially point defects, similar to low-energy electrons, and partially clusters, similar to neutrons. Point defects and clusters affect the electrical properties of silicon, in particular the recombination lifetime and majority-carrier density, in different ways. By comparing theoretical calculations of lifetime degradation and carrier removal based on a point-defect model and on a cluster model with the corresponding experimental data for electron, proton, and neutron radiations, it is concluded that carrier removal scales more closely with the total energy deposited in the lattice–that is, with the total number of point defects created by the radiation. On the other hand, lifetime degradation is affected more strongly by the cluster nature of the damage, and its relative damage curve can be estimated better by the cluster model. (5 tables) (auth)

14999 HIGH-VOLTAGE ELECTRON MICROSCOPE STUDIES OF LOW-TEMPERATURE RADIATION DAMAGE IN SILICON. Foell, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 233-239 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Thin foils of high-purity silicon were investigated in a high-voltage electron microscope at temperatures T between 15 and 60°K at beam voltages between 400 and 650 kV (i.e., at voltages high enough for producing atomic displacements). Between 10 and 35°K, the formation of point defect clusters of so far unknown type and with diameters d of about 50 Å was observed. These clusters are formed in p-type material at a significantly lower electron dose than in n-type material. At $T > 35$°K, the number of clusters decreases and their sizes grow. At the same time the spatial distribution of the clusters becomes inhomogeneous, the major part being localized near the upper foil surface. In cases where the defect nature could be analysed in more detail, all of them were found to be of interstitial type. (auth)

15000 LCAO–MO CALCULATIONS ON THE SELF-INTERSTITIAL AND FRENKEL PAIRS IN TELLURIUM. Weigel, C. (State Univ. of New York, Albany); Landwehr, G.; Corbett, J. W. pp 241-248 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Presented are results of LCAO–MO cluster calculations based on the extended Hueckel theory for the self-interstitial and Frenkel pairs in the trigonal tellurium lattice. For the interstitial, a position appears to be favoured where there are four nearest neighbours located in three different chains. Deep donor levels are found for this interstitial position. The Frenkel pair can act as both donor and acceptor; but due to the positions of the occupied and unoccupied levels in the gap, it requires less energy to make a hole in the valence band than to put an electron in the conduction band. This seems to conform with the experimentally observed increase of the hole concentration in tellurium after electron irradiation. The formation energy of the Frenkel pair is calculated to be about 2 eV, which agrees in the order of magnitude with other estimates in the literature. (auth)

15001 POINT DEFECT AND DISLOCATION INTERACTION IN ELECTRON-IRRADIATED TELLURIUM. Saffert, R. (Univ. of Wuerzburg, Ger.); Gmelin, E.; Landwehr, G. pp 249-255 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Low-temperature irradiation experiments of tellurium single crystals with 1-MeV electrons reveal at least three annealing stages at 50, 110, and 140°K. The dose dependence of the measured quantities (electrical resistivity, Hall coefficient, Seebeck coefficient and Nernst–Ettingshausen coefficient) is anistropic. In the orientation where the electrical current j is parallel to the crystallographic c axes the carrier mobility is initially increased by irradiation. This effect is explained by the presence of dislocations. A model based on the interaction of point defects with dislocations is proposed which can explain all irradiation experiments at least qualitatively. The dose dependence of carrier concentration and mobility can be described quantitatively. (auth)

15002 LATTICE DEFECTS AND PHOTOCONDUCTIVE LIFETIME IN CdTe SINGLE CRYSTALS GROWN FROM SOLUTION. Taguchi, T.; Shirafuji, J.; Inuishi, Y. (Osaka Univ.). pp 272-279 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Photoluminescence spectra, photoconductive lifetime, and electrical properties together with their irradiation effects were investigated in CdTe single crystals grown from melt and from solution of Te or CdCl. The 1.1-eV emission band appearing after electron irradiation at 77°K anneals at 120°K and is assigned to a simple Te vacancy. The electron trapping level at 0.06 eV below the conduction band is characteristic in Cl-doped samples and is associated with Cl donors. In n-type samples, the 0.33 eV hole trap is peculiarly observed in photoconductivity, but not in photoluminescence spectra, showing an inherent property of the 0.33 eV level. The 160 meV acceptor level which relates to the 1.42 eV emission band is possibly due to a complex involving a Te vacancy. The common annealing stage at 320–350 K is observed in electrical properties, photoluminescence spectra and photoconductive lifetime in p-type samples irradiated with electrons. (auth)

15003 LOW-TEMPERATURE IRRADIATION AND ANNEALING OF n-TYPE CdTe. Caillot, M. (Univ., Paris). pp 280-287 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

1.5-MeV electron irradiations of n-type compensated or uncompensated CdTe were performed at liquid helium temperature. In compensated samples, the conductivity measured at 20°K decreases linearly with the flux whereas the one measured at 4.2°K decreases exponentially with the dose. This latter effect is interpreted by a hopping conduction whose activation energy increases linearly with the dose of irradiation. The behaviour of the conductivity during isochronal annealings allows to separate the effect due to traps present before irradiation from the one due to defects produced by irradiation. Extrinsic photoconductivity and conductivity experiments show an annealing stage beginning at 135°K in all samples. All defects produced by irradiation do not recover at

this temperature and permanent defects still remain at room temperature. From photoconductivity spectra, the energy level of the defect which anneals is determined as $E_v + 0.45$ eV. Isothermal annealings show at first the kinetics are of the first order. This is interpreted as a recombination of vacancy–interstitial pairs with a migration energy of 0.25 eV. However, the end of reaction is typical of a diffusion-controlled recombination of correlated pairs. The nature of the defect which recovers at 135°K is discussed. (6 fig) (auth)

15004 OPTICAL PROPERTIES OF A DONOR-CADMIUM VACANCY COMPLEX IN CdTe. Marfaing, Y. (Laboratoire de Physique des Solides, CNRS, Bellevue, France); Triboulet, R.; Furgolle, B.; Hoclet, M.; Vandevyver, M. pp 288-293 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

A well-resolved optical absorption spectrum was observed on undoped p-type CdTe and is interpreted in terms of transitions of holes bound to a deep acceptor. A first excitation transition appears at 131 MeV) and is followed by two series of phonon replicas. The corresponding periods are the LO phonon energy (21 MeV) and a small quantum of 3.6 MeV. The occurrence of this spectrum is correlated with a Te excess in the samples. Furthermore photoluminescence data obtained on purposely doped samples show that a group III donor is involved in the acceptor centre. Hence it is concluded that this center is a close association between cadmium vacancies and group III donors. This is in agreement with the existence of a low-frequency vibronic mode, which is expected considering the weakening of force constants around vacancies. (auth)

15005 OPTICAL ABSORPTION, PHOTOCONDUCTIVITY, AND PHOTO-HALL EFFECT IN ELECTRON-IRRADIATED SEMICONDUCTING DIAMOND. Vermeulen, L. A. (Univ. of Witwatersrand, Johannesburg); Clark, C. D.; Walker, J. pp 294-300 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

A study is made of the optical absorption and photoconductivity spectra of electron-irradiated semiconducting diamonds. Photoconduction minima are observed at the same energy as the GRI optical absorption lines while sharp line photoconductivity maxima occur at the same energies as the GR2 → 8 absorption lines. Possible mechanisms are discussed. The GR1 → 8 lines appear in semiconducting diamonds only after the pre-existing acceptor states have been compensated. Photo-Hall effect measurements show that the majority carriers produced by optical excitation in the region of the GR2 → 8 lines (2.7–3.3 eV) are positive holes. The significance of these results for the neutral vacancy model of the GR1 center is discussed. (auth)

15006 RADIATION DAMAGE AT LOW TEMPERATURE IN BORON-DOPED SYNTHETIC DIAMOND. Massarani, B.; Bourgoin, J. C. (Groupe de Physique des Solides de l'ENS, Paris). pp 301-307 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Introduction of defects by electron irradiation at 8°K and their annealing at 8 to 300°K were studied using conductivity measurements. Effects of dose and energy were also studied. The threshold energy is on the order of 50 eV. (DLC)

15007 LOW-TEMPERATURE THERMAL CONDUCTIVITY OF 0.75 MeV ELECTRON-IRRADIATED TYPE IIa DIAMONDS; EVIDENCE FOR INTERSTITIAL MIGRATION BELOW ROOM TEMPERATURE. Vandersande, J. W. (Univ. of Witwatersrand, Johannesburg). pp 308-316 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The low-temperature thermal conductivity of type IIa diamonds irradiated at room temperature and at 77°K differed, although large interstitial aggregates were found in both. The difference between the results of the irradiations at the two temperatures is most likely due to the different instantaneous concentrations of interstitials. The results of the 77°K irradiation can only be explained if the interstitial becomes mobile between 77 and 300°K. (auth)

15008 OPTICAL AND UNIAXIAL STRESS STUDIES OF IRRADIATION-INDUCED DEFECTS IN DIAMOND. Walker, J. (Univ. of Reading, Eng.). pp 317-324 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Two zero-phonon lines were studied in irradiated diamond using optical absorption and uniaxial stress. TR12 (470 nm, 2.64 eV) is shown to be due to a σ oscillator at a defect of monoclinic I symmetry, and a possible model is the divacancy. 3H (503 nm, 2.46 eV) is due to a π ⟨110⟩ oscillator at a rhombic I defect, and a suggested model is the oxygen–vacancy pair. The relationship of 3H to the H3 and S1 optical systems in diamond, which also have zero-phonon lines at 503 nm, is discussed. (auth)

15009 EPR IDENTIFICATION OF ZINC VACANCY/ZINC INTERSTITIAL CLOSE PAIRS IN IRRADIATED ZnSe. Watkins, G. D. (General Electric Corporate Research and Development, Schenectady, NY). pp 338-345 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).
Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Irradiation of ZnSe at 20·4°K with 1·5-MeV electrons produces four distinct EPR spectra which are identified as arising from simple zinc vacancy/zinc interstitial close pairs of different microscopic configuration. Correlation of defect alignment with incident electron beam direction confirms the identification. Uniaxial stress alignment studies are also described. Specific microscopic models are proposed for each. Isolated zinc vacancies are also produced but with zero initial production rate, suggesting that their production is a two-step process, the first being the formation of close pairs. (auth)

15010 ELECTRICAL PROPERTIES AND ENERGY LEVELS IN ELECTRON-IRRADIATED n-TYPE InP. Leloup, J.; Djerassi, H.; Albany, H. J. (CEN de Saclay, Gif-sur-Yvette, France). pp 367-372 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

n-type doped InP was irradiated with 3-MeV electrons at 15 or 50°C. The Hall coefficient and electrical resistivity were measured from 10 to 300°K before and after each irradiation. The effect of irradiation is to give rise to a decrease of the carrier concentration n_0 and an increase of the resistivity with increasing the integrated flux ϕ. In addition to acceptor centres, donor centers are also introduced by irradiation. This was particularly observed in a sample with initial $n_0 = 1{\cdot}6 \times 10^{16}$ cm^{-3}, irradiated at 15°C. At high ϕ ($4 - 6 \times 10^{16}$ electrons/cm^2), two donor centers are observed: shallow levels (~4 meV) related to the initial donor impurities, and a deep energy level estimated to be of about 130 meV. The temperature of irradiation at 15 or 50°C is found to have an important effect, and an annealing stage is observed to take place in a temperature interval around 50°C. (auth)

15011 HIGH-RESOLUTION LUMINESCENCE SCANNING AROUND DISLOCATIONS IN GALLIUM ARSENIDE AT HELIUM TEMPERATURES. Heinke, W. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart). pp 380-386 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Photoluminescence spectra are taken with high spatial sample resolution on GaAs specimens at helium temperatures. A special cryostat in combination with laser excitation and a microscope optics system were used to get a resolution better than 5 μm. (100)-oriented samples having carrier concentrations n = 3... 4×10^{17} cm^{-3} (Se doping) were investigated. Drastic reductions of emission intensity is observed for the donor to valence band transition in the immediate vicinity of dislocations. This reduction is extremely strong for dislocations freshly introduced by bending techniques; annealing at 600°C partly restores this intensity. Emission of self-activated luminescence from vacancy-impurity complexes is observed after annealing of fresh dislocations. Detailed iso-intensity mappings around as-grown dislocations are shown and compared with etch petterns. Depletion of acceptors around the as-grown dislocation is found, which appears to be caused by a Cottrell attraction. (auth)

15012 REDISTRIBUTION OF BORON IN SILICON THROUGH HIGH-TEMPERATURE PROTON IRRADIATION. Baruch, P. (Groupe de Physique des Solides de l'ENS, Paris); Monnier, J.; Blanchard, B.; Castaing. pp 453-460 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The effect of high-temperature proton irradiation on impurity distribution is shown to involve more complicated effects than the enhancement of diffusion through an increase of defect density. In the case of boron in silicon, studied by secondary ion mass spectrometry, the distribution is largely perturbed at the end of

the proton range, after 850°C irradiation by 150–400 keV protons, with fluxes from 1 to 6×10^{17} protons/cm^2. Both in uniformly doped and in prediffused samples, accumulation and depletion of boron can be seen in a narrow region, involving atom movement against the initial concentration gradient, or creating such a gradient. Such an effect must be attributed to interaction of boron with the defects created by irradiation, giving species with different mobilities; it is possible to give a picture where interstitials, created directly or by the Watkins mechanism, flow out from the damage peak, while by a competing mechanism, immobile clusters or precipitates drain part of the substitutional impurities. These two effects would deplete the substitutional impurity near the damage peak, but the last one would give boron accumulation at this precise location, yielding the observed profile. The verification of this model is under way. The generalization of this effect to other impurities has to be studied, as the consequences in the analysis of enhanced diffusion experiments. (auth)

15013 INVESTIGATION OF DEFECT DIFFUSION IN OXYGEN-IMPLANTED GaAs BY SCANNING ELECTRON MICROSCOPE. Favennec, P. N.; Boulet, J. P.; L'Haridon, H.; Rao, E. V. K. (Centre National d'Etudes des Telecommunications, Lannion, France). pp 481–486 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Investigation of oxygen ion-implanted GaAs layers is carried out with the help of SEM and capacitance measurements. SEM analysis in simultaneous mode display, emissive and luminescence, permitted to estimate the thickness of the implant-damaged layer. A comparative study of implanted layers by the above method and by capacitance measurements led us to the following conclusions. A part of nonradiative recombination centers, not participating in electrical compensation, is observed beyond implanted-ion ranges. These centers show a tendency to diffuse into the bulk both during implantation and during anneal to temperatures of about 360°C. (auth)

15014 DISTRIBUTION OF SECONDARY DEFECTS IN BORON-IMPLANTED SILICON. Lecrosnier, D. P. (Centre National d'Etudes des Telecommunications, Lannion, France); Pelous, G. P.; Henoc, P. pp 487–493 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Transmission electron microscopy observation were performed on 1-MeV boron-implanted silicon. The use of such a high energy gives a range of 1·86 μm for boron atoms and provides samples with well-buried layers. By anodic oxidation and HF stripping, layers of controlled thickness were removed before the samples were back-thinned to about 1000 Å for microscopy observation. This procedure allowed to observe the variation of density and the nature of defects with depth. The samples were implanted at room temperature with doses of 10^{15} or 10^{16} ions/cm^2 in a direction 7° off the ⟨111⟩ axis. Annealing was performed at 1000°C during 30 min in a nitrogen atmosphere. The observations indicate no defects in the region crossed by the ions. This region extends from the surface to about 1·5 μm and appears as a perfect crystal showing that primary implantation defects have disappeared. On the other hand, from 1·6 to 2 μm, perfect dislocation loops are the predominant defects detected. These dislocations lie on the {111} plane parallel to the surface. In all cases, their nature is shown to be vacancy type with a Burgers vector of (a/2) $(1\bar{1}0)$. The density, measured as the length of dislocation per surface unit, presents a maximum value located at the peak of boron distribution. These results indicate a long-range interaction between primary defects and impurities. A possible adsorption of boron atoms along these dislocations is suggested. To strengthen this assumption, channelling experiments on the boron localization are now in progress. (auth)

15015 ION DAMAGE AND PHOSPHORUS DIFFUSION GETTERING OF Au IN Si. Seidel, T. E.; Meek, R. L.; Cullis, A. G. (Bell Labs., Murray Hill, NJ). pp 494–503 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The residual disorder caused by different implanted ions after annealing at elevated temperatures (850–1150°C) is dependent upon the ion species. The gettering of Au by damaged layers produced by Ar, O, P, Si, As, and B was quantitatively compared to gettering by phosphorus diffusion. Each individual comparison was made between opposite surfaces of a Si sample by use of Rutherford backscattering. The damage disorder was quantitatively measured by backscattering and structurally studied using electron microscopy. Ar-ion damaged layers were more effective for gettering Au than were phosphorus diffused layers below about 1000°C and equally effective up to 1150°C. The relative gettering efficiency of the damage produced by other ions studied was less than that of phosphorus diffusion at 1000°C and was ranked in the order Ar ≳ O > Si ≳ As ≳ B. In general, the relative gettering efficiency of ion damaged layers was related to the amount and type of disorder after annealing. (auth)

15016 TSC MEASUREMENTS OF BORON-IMPLANTED SILICON JUNCTIONS. Muller, J. C.; Stuck, R.; Siffert, P. (Centre de Recherches Nucleaires, Strasbourg). pp 513–520 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

Thermally stimulated current (TSC) measurements were performed directly on junctions formed by implantation of low energy (less than 100 keV) boron ions into n-type silicon after annealing treatments at different temperatures between 100 and 500°C. The TSC curves were analysed by a new method based on the measurement of the mean time before re-emission of the trapped carriers. The influence of several parameters, such as bombarding energy, implant temperature and resistivity of the starting silicon, was considered. If the implantations are performed at room temperature, for a bombarding energy of 15 keV only one level is found at E_v + 0·26 eV and this is attributed to the divacancy. For an energy of 60 keV additional levels at E_c – 0·18, E_v + 0·31, and E_v – 0·44 eV appear. If the implantation occurs at liquid nitrogen temperature, even for 60 keV only the level at E_v + 0·26 eV is present. (auth)

15017 NUCLEAR MAGNETIC RESONANCE OF NEUTRON-ACTIVATED SHORT-LIVED NUCLEI: A METHOD TO STUDY (n,γ)-INDUCED LATTICE DEFECTS. Ackermann, H. (Univ., Heidelberg); Dubbers, D.; Grupp, M.; Heitjans, P.; Stoeckmann, H. J.; Winnacker, A.; von Blanckenhagen, P. pp 579–580 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

If the activated nucleus is β active, its microscopic location may be determined with the use of polarized thermal neutrons; the β decay, showing an asymmetric distribution, can be used to monitor the nuclear polarization. This technique was applied to the In III-V compounds and to the silver halides. Results for the location of ^{116}In and ^{110}Ag are summarized. (DLC)

15018 NEW TECHNIQUE FOR DEFECT SPECTROSCOPY IN SEMICONDUCTORS: APPLICATION TO 1 MeV ELECTRON-IRRADIATED N-GaAs. Lang, D. V.; Kimerling, L. C. (Bell Labs., Murray Hill, NJ). pp 581–588 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

A new technique for defect spectroscopy in semiconductors is presented. This is a high-frequency junction capacitance transient thermal scanning method which is able to display the spectrum of defect levels near a p-n junction of Schottky barrier as positive and negative peaks on a flat baseline as a function of temperature. It is sensitive, rapid, and easy to analyse. The sign of the peak indicates whether the level is near the conduction or valence band, the height of the peak is proportional to the trap concentration, and the position in temperature of the peak is uniquely determined by the thermal emission properties of the level. In addition one can measure the activation energy for emission, concentration profile, and electron and hole capture cross sections for each level. The technique is illustrated by its application to room-temperature 1-MeV electron-irradiated n-GaAs. Six defect levels are observed to enter linearly with electron fluence with two additional defect levels present in the as-grown material. The activation energy for emission and introduction rate is measured for each level. (auth)

15019 RECOMBINATION-ENHANCED DEFECT REACTIONS IN SEMICONDUCTORS. Kimerling, L. C.; Lang, D. V. (Bell Labs., Murray Hill, NJ). pp 589–593 of Lattice Defects in Semiconductors, 1974. Bristol, Eng.; Inst. of Physics (1975).

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974). See CONF-740729-.

The enhancement of defect annealing reactions in semiconductors under conditions of minority carrier injection has been observed directly. The defects were produced at room temperature in GaAs by 1-MeV electron irradiation and observed by transient junction capacitance techniques. Steady state and alternating (Bourgoin) charge-state effects have been investigated independently and determined to be not operative. The data clearly relate the enhanced defect annealing to electron–hole recombination processes at the defect. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 13924 and 14430.

15020 (REG/G-5.29(Rev.1)(6-75)) NUCLEAR MATERIAL CONTROL SYSTEMS FOR NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 1p. NRC.

Paragraph 70.51(c) of 10 CFR Part 70 requires each licensee who is authorized to possess at any one time special nuclear material in a quantity exceeding one effective kilogram to establish, maintain, and follow written material control and accounting procedures that are sufficient to enable the licensee to account for the special nuclear material in his possession under license. While other paragraphs and sections of Part 70 provide specific requirements for nuclear material control systems for fuel cycle plants, such detailed requirements are not included for nuclear power reactors. This guide identifies elements acceptable to the NRC staff for a nuclear material control system for nuclear power reactors. (auth)

15021 (WASH-1335) METHODS FOR THE ACCOUNTABILITY OF PLUTONIUM DIOXIDE. Gutmacher, R. G.; Stephens, F.; Ernst, K.; Turel, S. P.; Shea, T. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.; USAEC Directorate of Regulatory Standards, Washington, D.C.). Dec 1974. 189p. Dep. NTIS $12.50.

Procedures for the determination of the total plutonium and the total fissile plutonium (^{239}Pu and ^{241}Pu) in plutonium dioxide are presented. The quantitative analysis procedures include: (1) controlled-potential coulometry using a sulfuric acid supporting electrolyte and (2) amperometric titration with iron. Isotopic analysis procedures include: (1) ionization mass spectrometry and (2) alpha spectrometry. Metal impurities are determined by the carrier distillation technique and by spectrophotometry. (TFD)

Disposal and Storage

Refer also to abstracts 13905, 13906, 14261, 14276, 14302, 14303, 14306, and 16054.

15022 (BNWL-1913) NUCLEAR WASTE MANAGEMENT AND TRANSPORTATION QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1975. Platt, A. M. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-1830. 79p. Dep. NTIS $7.60.

Research progress is reported on all Division of Waste Management and Transportation funded programs at Battelle, Pacific Northwest Laboratories, with the exception of the Commercial Radioactive Waste Fixation Program. Topics reported on include advanced methods for management and disposal of radioactive wastes; separation of actinide elements from radioactive waste; decontamination and densification of chop-leach cladding residues; pyrolysis-incineration of combustible alpha wastes; tritium separation and fixation; characteristics of 300 and WYE burial grounds; disposition of retired contaminated facilities at Hanford; development of packaging technology for $Pu(NO_3)_4$ shipment; and transportation safety studies. (TFD)

15023 (DPST-73-125-4) SAVANNAH RIVER LABORATORY QUARTERLY REPORT, OCTOBER–DECEMBER 1973. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 45p. Dep. NTIS $5.25.

Activities during Oct. through Dec. 1973 at the Savannah River Laboratory are reported. Information is included on: long-term waste management; interim waste solidification; distribution of ^{239}Pu and ^{235}U in waste sludge; volume of stored wastes; cleanup of waste evaporator distillate; corrosion of coils during sluicing of sludge from waste storage tanks; and ^{3}H migration in the burial soil. (LCL)

15024 (DPST-74-125-2) WASTE MANAGEMENT. Savannah River Laboratory Quarterly Report, April–June 1974. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 43p. Dep. NTIS $5.25.

Preliminary leach rates were measured for strontium and plutonium from concrete waste forms containing simulated waste sludge. Tests indicate adequate compressive strength of concretes containing up to 40% dried simulated sludge. Development was continued of glasses for solidification of sludge and cesium-containing minerals. Irradiation, devitrification, and volatilization were studied. Calculations predict that decay helium does not damage sludge-glass waste forms significantly. Remote gamma analysis was adapted to monitor waste processing. Tritium migration from buried extracted Li-Al melts was measured in the program to define possible pathways of tritium to the public zone. Calculations with an improved computer code indicate that cracks up to 2 feed long in filled waste tanks would not grow by ductile mechanism during a postulated defined earthquake. Fracture tests showed that initial ductile crack extension can begin at nominal applied stresses below the yield stress, but showed no extension of cracks visible on the surface until applied stress approximately equalled yield stress. Phosphate solidification is impractical for interim storage of Savannah River wastes because the ^{137}Cs in existing plant waste would generate enough heat of melt the phosphate complexes. (auth)

15025 (INIS-mf-1639(Vol.1), pp 38-43) DESIGNED MODEL FOR THE CHOICE OF THE RADIOACTIVE WASTE DISPOSAL VERSIONS FOR NUCLEAR POWER PLANTS AND FUEL REPROCESSING PLANTS. Fisher, V.; Bul, G. 1973. (In Russian).

From proceedings of a scientific and technical conference; Colobjeg, Poland (2 Oct 1972).

In investigation into liquid, solid and gaseous radioactive waste processing and surface decontamination.

A program is described which will make possible an economic evaluation of reasonable combinations of techniques and technology for processing and permanent disposal of radioactive wastes from nuclear facilities. Costs, consumption, and safety criteria are considered. Functional relations are discussed, and the capacity and limits of the program are considered. (INIS)

15026 (INIS-mf-1639(Vol.1), pp 44-52) INVESTIGATIONS OF VERSIONS FOR THE CHOICE OF FINAL RADIOACTIVE WASTE DISPOSAL METHOD FROM NUCLEAR FACILITIES OF GDR. Fisher, V.; Kerner, V.; Richter, D. (Staatliche Zentrale fuer Strahlenschutz, Berlin). 1973. (In Russian).

From proceedings of a scientific and technical conference; Colobjeg, Poland (2 Oct 1972).

In investigation into liquid, solid and gaseous radioactive waste processing and surface decontamination.

After mentioning the most important technological factors that affect waste disposal, e.g., the type and properties of the wastes from a nuclear power station and equipment for cycling nuclear fuel, possible technologies for processing and permanently disposing of radioactive wastes are considered. Methods for final disposal are discussed from the economic and safety viewpoints, and methods suitable for conditions in the German Democratic Republic are evaluated. (INIS)

15027 (INIS-mf-1639(Vol. 1), pp 60-67) PRESENT STATUS AND PERSPECTIVES OF RADIOACTIVE WASTE DISPOSAL IN CSSR. Petr, Y.; Prokop, M. (Energoprojekt, Prague). 1973. (In Russian).

From proceedings of a scientific and technical conference; Colobjeg, Poland (2 Oct 1972).

In investigation into liquid, solid and gaseous radioactive waste processing and surface decontamination.

The present state of radioactive waste disposal is analyzed, controlling conditions are evaluated, and future directions in the development of atomic energy in Czechoslovakia are discussed. Specific factors affecting the general concept of radioactive waste disposal from nuclear power plants in Czechoslovakia are considered. (INIS)

15028 (INIS-mf-1639(Vol. 1), pp 68-70) CREATION OF NEW FACILITY FOR RADIOACTIVE WASTE PROCESSING AND STORAGE IN HPR. Fekher, L.; Gach, F.; Khirling, J. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1973. (In Russian).

From proceedings of a scientific and technical conference; Colobjeg, Poland (2 Oct 1972).

In investigation into liquid, solid and gaseous radioactive waste processing and surface decontamination.

A station constructed in Hungary in 1959 for storage of radioactive wastes was a temporary installation. In selecting the site for a new station the area in a 100-mile radius of Budapest was considered. Processing of the wastes by a chemical method, evaporation, and ion exchange is planned. Hydrogeological conditions of the area are favorable. Permanent storage of the concentrates underground in concrete in mine shafts is planned. (INIS)

15029 (NP-20456, pp vp Paper 9) RADIOACTIVE WASTE MANAGEMENT FOR REACTORS. Rodger, W. A. (Nuclear Safety Associates, Bethesda, MD). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Rasioactive waste management practices at nuclear power plants are summarized. The types of waste produced and methods for treating various types of wastes are described. The waste management systems, including simplified flow diagrams, for typical boiling water reactors and pressurized water reactors are discussed. (RCK)

15030 (SAND-74-0360) FEASIBILITY STUDY: A DEEP OCEAN SEA FLOOR WORK VEHICLE. Williams, D. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. 27p. Dep. NTIS $4.50.

Results of an investigation of the feasibility of designing a work vehicle capable of operating on the ocean floor at depths down to 15,000 ft are presented. The justification for the investigation, design goals, design proposals, and progress achieved during the six-month period in which the study took place are discussed. (auth)

15031 (SAND-74-0410) SEABED DISPOSAL PROGRAM: A FIRST-YEAR REPORT, DECEMBER 1974. Bishop, W. P. (ed.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 504p. Dep. NTIS $28.25.

A summary is given of the progress made by a study group, composed of persons from many disciplines and organizations, which was formed to examine certain areas of the world's oceans to determine whether it is feasible to use such areas, or the ocean floor beneath them, as permanent disposal sites for high-level nuclear wastes. (auth)

15032 CONFINEMENT ENCLOSURE FOR RADIOACTIVE SUBSTANCES OR WASTE. (to Technigaz, 75 - Paris (France)). French Patent 2,209,983/A/. 13 Dec 1972. 25p. (In French).

According to the invention, the enclosure comprises an outer vault of reinforced concrete forming the rigid supporting structure of two vessels formed of stainless steel corrugated thin sheets. Cooling fluid conduits are located adjacent the walls of the vessels. The invention can be applied to the confinement of radioactive substances or waste. (FR)

Handling Equipment and Procedures

Refer also to abstract 16685.

15033 (DOCKET-701729-4) FUEL RECEIVING AND STORAGE STATION. License Application, Amendment 4. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). Apr 1975. 36p. Dep. NTIS $5.00.

Amendment No. 4 of the application for licensing the Barnwell Fuel Processing Plant is presented. Information is included on: the quantity and characteristics of nuclear fuel assemblies which can be received and stored; specifications limiting the outside washdown of contaminated casks received for unloading; and definition of environmental monitoring program. (LCL)

15034 (LA-5930-MS) CAPSULE STORAGE AND DENSITY-ANALOG TECHNIQUES. Paxton, H. C. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-ENG-36. 12p. Dep. NTIS $4.00.

Density-analog schemes for describing critical arrays of fissile units have a long history. They originated as methods for generalizing results of subcritical measurements on weapon capsules. Such measurements were needed to establish reasonably efficient rules for capsule storage. Although specific density-analog models have been improved throughout the years, they are now largely replaced by comprehensive tabulations of critical-lattice parameters. Certain simplified forms are still useful as convenient formulas for extrapolation or for gross sorting of safety features. (auth)

15035 (UCCND-CSD-INF-48) CRITICALITY INDICATOR SYSTEM FOR STORAGE OF FISSILE MATERIALS. Thomas, J. T. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 25p. Dep. NTIS $4.25.

Experimental and calculated criticality data for neutron-coupled subcritical components in reflected arrays are used as bases to formulate a system for nuclear criticality safety control in the storage of fissile materials. A criticality indexing method is described and is applied to 46 different forms of fissile materials for storage in concrete reflected arrays. (auth)

15036 DRY CASK HANDLING SYSTEM FOR SHIPPING NUCLEAR FUEL. Jones, C. R. (to Transfer Systems Incorporated). US Patent 3,883,012. 13 May 1975. Filed date 9 Oct 1973. 6p.

A nuclear facility is described for improved handling of a shipping cask for nuclear fuel. After being brought into the building, the cask is lowered into a tank mounted on a transporter, which then carries the tank into a position under an auxiliary well to which it is sealed. Fuel can then be loaded into or unloaded from the cask via the auxiliary well which is flooded. Throughout the procedure, the cask surface remains dry. (Official Gazette)

15037 STORAGE TANK FOR FISSILE MATERIAL. Siemens, D. H., Jr. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,212,820/D/. 5 Nov 1973. 7p. (In French).

The invention concerns storage tanks for the storage of chemical solutions. The arrangement consists of narrow annular tanks arranged concentrically with separation walls placed in the annular space between the concentric tanks. This arrangement is applicable to the storage of chemical solutions containing radioactive products. (tr-FR)

Transportation

Refer also to abstract 14262.

15038 (BNWL-CC-1546) BNW MODEL 10 SHIPPING CONTAINER FOR NON-IRRADIATED FISSIONABLE MATERIALS: BASIS FOR DOT SPECIAL PERMIT. Brown, C. L.; Lawrence, L. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1968. Contract AT(45-1)-1830. 48p. Dep. NTIS $5.50.

Design and safety aspects of the BNW Model 10 shipping container (formerly called the EBWR shipping tube) is described in support of an application for a DOT Special Permit to authorize its use in shipment of dry, unmoderated forms of Pu, ^{233}U, ^{235}U, and all forms of ^{237}Np and ^{241}Am, by highway, railway, and airway. (TFD)

15039 (DOCKET-701729-1) FUEL RECEIVING AND STORAGE STATION. Responses to AEC Request for Additional Information Re the Fuel Receiving and Storage Station and Supporting Calculations Related to Cask Energy Absorption System. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). 19 Dec 1974. 33p. Dep. NTIS $4.75 Micro.

Eight questions from the USAEC Directorate of Licensing related to the impact safety and the criticality safety of casks to be used at the Barnwell Fuel Processing Plant for transporting and storing fuel are presented and answered. (LCL)

15040 (DOCKET-701729-2) FUEL RECEIVING AND STORAGE STATION. Technical Description in Support of Application for FRSS Operation. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). Feb. 1975. 121p. Dep. NTIS $9.25.

Questions from the USAEC Directorate of Licensing related to the safety of casks used to transport and store fuel elements at the Barnwell Fuel Reprocessing Plant and to facilities and procedures used in the plant are answered. (LCL)

15041 (DPSPU-74-124-1) SAFETY ANALYSIS REPORT: PACKAGES ^{238}Pu OXIDE SHIPPING CASK (PACKAGING OF FISSILE AND OTHER RADIOACTIVE MATERIALS). Final Report. Evans, J. E.; Gates, A. A. (comps.). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jun 1975. Contract AT(07-2)-1. 102p. Dep. NTIS $8.25.

Plutonium-238 (as PuO_2 powder) is shipped in triple-container stainless steel shipping casks in compliance with ERDA Manual Chapter 0529 (ERDAM 0529), Safety Standards for the Packaging of Fissile and Other Radioactive Materials. (auth)

15042 (ICP-1077) SAFETY ANALYSIS REPORT FOR PACKAGING KRYPTON SHIPPING CONTAINER USA/5958/BL (ERDA-ID). Nielsen, C. W. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). Jun 1975. Contract AT(10-1)-1375. vp. Dep. NTIS $5.45.

A safety review of possible hazards associated with shipment of radioactive krypton-85 gas in the krypton shipping container was completed. The cask is described, and transfer procedures and control methods are discussed. A safety analysis covering the credible consequences of radiation exposures, contamination, and fire and explosion is presented. Criticality was not evaluated,

because fissionable materials are excluded from this cask. The safety analysis indicates that the krypton shipping container may be used within conditions specified in AECM 0529 without undue hazards. (auth)

15043 (NP-20456, pp vp Paper 15) ARE NUCLEAR SHIPMENTS REALLY SAFE. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The studies indicate that the probability of death, injury, or massive property loss due to transportation of radioactive materials is: (1) determinable, (2) not zero, and (3) very small. In projecting the total accident probability for transportation of radioactive materials to and from nuclear power reactors and fuel reprocessing plants, it seems obvious that the overall radiological consequences of the total accident spectrum will be several orders of magnitude below the more common nonradiological causes. It further appears that radiation doses to transportation workers and the general public during the normal course of transportation will be limited to a small fraction of the total permissible annual dose, and then only to an extremely small segment of the population. The various studies show clearly that the likelihood of a catastrophic nuclear transport accident is so infinitesimal that, for all practical purposes, it can be confidently said that one will never happen. (auth)

15044 (REG/G-7.4(6.75)) LEAKAGE TESTS ON PACKAGES FOR SHIPMENT OF RADIOACTIVE MATERIALS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 1p. NRC.

The Commission's regulation, 10 CFR Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions," applies to licensees of the Commission who transport licensed material or who deliver licensed material to a carrier for transport. Certain standards and requirements in 10 CFR Part 71 prescribe that there will be no release, or limited release, of radioactive materials from a package or component of a package under certain conditions. This regulatory guide identifies a leak test standard acceptable to the NRC staff for use in demonstrating that packages of radioactive material comply with these containment requirements. (TFD)

15045 IMPROVEMENT IN WRAPPINGS FOR CONFINING AND TRANSPORTING RADIOACTIVE SUBSTANCES. (to Robatel-S. L. P. I., 69 - Lyon (France)). French Patent 2,212,614/A/. 28 Dec 1972. 7p. (In French).

With a view to preventing the cooling pins from being in contact with the polluted water of the loading and unloading pools, there is provided a perforated wall which acts in the manner of a backing surface for a removable cover fixed in position by means of expansible gaskets. At that moment, the cooling of the pins is achieved by causing water to stream from a ramp or chute, that water being expelled, together with the air blown through a coupling-inlet, through a lower port. This can be applied to the transport and confinement of radioactive substances. (FR)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 14418.

15046 (ANU-P-612) ATOMIC AND SOLID STATE PHYSICS WITH THE 14UD. Newton, C. S. (Australian National Univ., Canberra). Feb 1975. 33p. Dep. NTIS (US Sales Only) $4.75.

The use of energetic heavy ions in atomic and solid state physics is discussed. Topics that are discussed include: (1) properties of excited ions, (2) radiation damage studies by channeling, (3) energy loss of ions and range measurements, (4) oscillating effects in channeling, (5) x-ray production in solids, (6) coherence effects in channeling, and (7) formation of united atoms. (42 references, 13 fig) (AT)

15047 (LA-5959-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending January 31, 1975. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-eng-36. 87p. Dep. NTIS $5.45.

The continued development and testing of the accelerator are reported. Activities include engineering support, accelerator support, accelerator systems development, electronic instrumentation and computer systems, accelerator operations, experimental areas, large-spectrometer systems, research, practical applications of LAMPF, and management. (TFD)

15048 SHOOTING SPARROWS IN THE DARK. High Energy Physics File 2. Frisch, O. (Cambridge Univ., Eng.). New Sci.; 65: No. 940, 654-657(13 Mar 1975).

An historical survey of the results of the ingenuity of a few men, the inventors, in the field of high energy physics is given. The development of the present machines through the original "atom splitters", the Van de Graaff accelerators, the cyclotrons, the linacs, proton synchrotrons, and finally the Intersecting Storage Rings at CERN, is traced. The necessity for experimental halls in place of the traditional laboratories is discussed. Finally, the inventiveness which has gone into the design of detectors of the high energy particles, produced by the machines, is considered (UK)

15049 CODE OF PRACTICE FOR X—RAY THERAPY LINEAR ACCELERATORS. Wootton, P.; Almond, P.R.; Holt, J.G.; Hughes, D.B.; Jones, D.; Karzmark, C.J.; Schultz, R.J. (Task Group 10 of the Radiation Therapy Committee of the AAPM). Med. Phys. 2: No. 3, 110-122 (May 1975).

Details are presented on the tests that should be performed during the installation of a megavoltage linear accelerator. Also discussed are the dosimetry studies that should be done as part of the operation of the machine. Information in specific radiation monitoring equipment is provided. (AIP)

15050 ELECTRON ENERGY SPECTRUM IN HIGH-ENERGY NANOSECOND ACCELERATORS. Kremnev, V.V.; Mesyats, G.A.; Reznikov, V.P. (Atmospheric Optics Institute, Siberian Branch, Academy of Sciences of the USSR, Tomsk). Sov. Phys.—Tech. Phys. 19: No. 10, 1342-1344 (Apr 1975).

The effects of matching the storage line to the diode, the switching time, and circuit inductance on the electron energy spectrum of an accelerator beam are considered. The spectrum is analyzed for a linear load, a diode with a field emission cathode, a diode with a thermionic cathode (three-halves law) and a diode with explosive electron emission. Relationships are obtained for the spectrum amplitude and half-width and for the maximum electron energy in the beam. Equations are derived for estimating the effects on the energy spectrum of the electron beam of movement of the plasma front in a diode with explosive emission and of retardation in a foil at the diode output. (auth)

Auxiliaries and Components

15051 DESIGN OF EARTHQUAKE-PROOF STRUCTURE FOR KEK LINEAR ACCELERATOR TANK. Inagaki, S. (National Lab. for High Energy Physics, Ibaraki, Japan); Tanaka, J.; Baba, H.; Okumura, S.; Ikeda, S.; Fujita, R.; Kisaki, J.; Ilao, Y. Part. Accel.; 6: No. 2, 123-129(1975).

In order to avoid the stress due to thermal expansion and to avoid resonance with an earthquake, the KEK proton linear accelerator tank has as supports a so-called soft-structure. The design of the support is described, i.e., the idea of the structure, the calculation of the mechanical features (the natural frequency, the endurable acceleration, etc.) and experimental results with a brief comment on the damping factor. (auth)

15052 PROTECTION AGAINST IONIZING RADIATION ON THE WORKPLACE WITH A MEDICAL BETATRON SIEMENS 42 MeV. Stojanov, M.; Fiala, E. (Dept. of Radiation Hygiene, Brno). pp 279-290 of Proceedings of the 6th conference on radiation hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

The resulting level of radiation protection on the workplace of a high-energy betatron depend, first of all, upon the total layout plan of the workplace, choice of suitable shielding and equipment of the workplace with sufficiently effective ventilating units. According to one opinion, it is necessary to pay greatest attention to the shielding of useful beams and protection against scattered bremsstrahlung. Greater importance is given to the protection from concrete or baryte concrete; the protection by distance can be applied in conditions of medical betatron workplace only to a small extent. We consider the level of protection against scattered bremsstrahlung on the workplace in the Onkological Institute to be very good. Results in measurements of exposures in the neighborhood of the irradiation room and existing results of film dosimetry show that in the course of current operation the exposure of the service staff does not exceed $\frac{1}{10}$ of the maximum permissible value per year. In the wider neighborhood, where there is even flat coverage in the distance of about 200m, exposure rates can be neglected. Concrete shielding of the irradiation room is good protection against neutrons. Measurable values of neutron fluxes are only in the close neighborhood of the irradiation room entry, which if need be, can be shielded with paraffin. The proportion of non-stationary oxygen isotopes ^{15}O and nitrogen isotopes ^{13}N to the outside exposure is small, expecially if the workplace is sufficiently equipped with efficient ventilating units. Special attention must be paid to the manipulation with activated tubes used during the irradiation by high-energy electrons. The choice of patients, without the need of frequent exchange of tubes and short-time manipulation can minimize these exposures. According to measurements carried out and short-time following of personal doses, there is not any assumption, that the service staff will be exposed to doses exceeding $\frac{3}{10}$ of the maximum permissible values per year. (auth)

15053 EIGENFREQUENCIES AND CURRENTS OF HELICES WITH FINITE LENGTH. Sauter, E. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Nucl. Instrum. Methods; 125: No. 4, 557-569.

The electromagnetic theory of helices is developed for a better understanding of helically loaded resonators used in proton accelerators. Starting from Maxwell's equations, one derives following Hallén's theory a homogeneous integral equation for the first derivative of the current. The eigenvalue P depends only on the quantity q = R/h, where R and 2 h are the radius and the length of the helix. Parametrizing the eigenvalue and the current one gets formulas in a new range of q, which was not yet covered by the approximate analytic solution of Hallén. A comparison of calculated and measured frequencies gives excellent agreement. Finally, the case of helices with short-circuited ends is discussed. (auth)

Ion Sources and Injection and Extraction Systems

15054 (GSI-J-2-74, pp 160-164) EMITTANCE MEASUREMENT OF A PENNING ION SOURCE WITH AXIAL EXTRACTION. Klein, G.; Baumann, H.; Bethge, K. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

The emittance of the Penning ion source is determined by the measurement of the ion beam divergence in different distances from the beam axis. A two-slit-method was used. (GE)

15055 (GSI-J-2-74, pp 165-172) GENERATION OF MULTICHARGED IONS BY AN END EXTRACTION PENNING ION SOURCE. Nickel, W.; Rang, B.; Heinicke, E.; Bethge, K. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974.

(Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

An ion source is reported consisting of a combined system of a Penning-ion-source and a duoplasmatron. The ion source is used to generate multicharged ions. (GE)

15056 (GSI-J-2-74, pp 173-178) DEVELOPMENT OF A SOURCE FOR MULTICHARGED HEAVY IONS (EBIS) AND INVESTIGATION OF THE MULTI-ELECTRON TRANSFER OF ARGON IONS DURING THE TRANSMISSION THROUGH GASES AT ENERGIES OF 10 TO 100 keV. Clausnitzer, G.; Klinger, H.; Mueller, A.; Salzborn, E. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

The charge transfer cross sections for Ar-ions during the transmission trough N_2, Ne, Ar and Kr were investigated. The multicharged Ar-ions (up to 7+) had energies between 10 and 100 keV. In an electron beam ion source Xe- and Ar-ions up to 9+ could be achieved by successive ionization. (GE)

15057 (GSI-J-2-74, pp 183-197) DEVELOPMENT OF AN ELECTRON BEAM ION SOURCE FOR THE UNILAC. Becker, R.; Klein, H.; Kleinod, M. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

An electron beam ion source is described generating multicharged ions by successive ionization. The advantages are the uncoupling between ionization and electron generation in the electron gun and the application at the UNILAC. (WL)

15058 (NP-20343, pp 118-124) ION SOURCE DEVELOPMENT. Burkard, K. H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Dumanski, W.; Kirchner, R.; Lauppe, W.; Otto, H.; Roeckl, E.; Seckert, F. 15 Jun 1974. (In German).

In annual report, 1973.

15059 IONIZATION OF ATOMIC BEAMS WITH THE HELP OF CHARGE-EXCHANGE REACTIONS FOR PROCUCTION OF POLARIZED PROTONS AND DEUTERONS. Hammon, W.; Penselin, S.; Scholzen, A.; Simm, H. (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Nucl. Instrum. Methods; 125: No. 4, 571-577(1 May 1975). (In German).

Charge-exchange reactions were used in an atomic-beam polarized ion source instead of electron impact ionization for production of protons and deuterons. The reactions $H^+ + D \rightarrow H + D^+$ and $D^+ + H \rightarrow D + H^+$ were tested. 0.27 μA deuterons and 0.17 μA protons were produced mass-separated from the atomic beam. Behind the charge-exchange volume approximately 0.4 μA deuterons or 0.25 μA protons are available in the test source. The efficiency of ionization by charge exchange is about 4×10^{-4} and can be increased. (auth)

Ion Optics and Field Calculations

15060 (BARC-769) ORBIT DYNAMICS AND DESIGN THEORY FOR OPTIMIZATION OF SECTOR SHAPES IN ISOCHRONOUS CYCLOTRONS. Jain, A.; Divatia, A. S. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). 1974. 71p. Dep. NTIS (US Sales Only) $6.25.

The general theory for arriving at the sector shapes which will optimize the performance of a multiparticle variable energy cyclotron for the full spectrum of ions to be accelerated is discussed analytically within the framework of the hard edge approximation for spiral sectors. The basic requirements of optimum isochronism and focusing to be provided by the sector shapes for the full spectrum of particles to be accelerated are discussed. General equations for the orbit time period, and the betatron frequencies, are derived explicitly in terms of the sector geometry; a simultaneous solution of these equations to generate the optimum sector shapes is discussed. A differential reiterative corrective procedure based on orbit integration results on a scale model to improve the initial sector shapes is suggested. The basic features of the theory are verified by constructing the spiral sectors of an $N = 3$, $\frac{1}{2}$ mc^2 electron cyclotron magnet; calculations leading to the design and experimental details are described. Separated sectored cyclotrons are included in the general theory as a special case of the conventional hill valley type when the valley field tends to zero; thus the same set of equations can be used to generate the optimum sector shapes with the valley field equal to zero. Application of this set of equations is compared with the set of equations derived by the matrix multiplication method for the separated sectored cyclotrons and the two sets are found to give widely different results in the frequency for the same sector shapes. (auth)

15061 (IPP-0/24) OHMIC LOSSES OF A RELATIVISTIC ELECTRON RING MOVING CLOSE TO CONDUCTING WALLS OF FINITE THICKNESS. Merkel, P. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Oct 1974. 13p. INIS.

A relativistic electron ring moving along a conducting wall is acted on by a retarding force due to the ohmic losses of the image currents in the wall. This force is calculated for an electron ring moving coaxially along and close to a cylinder of finite thickness. The dependence of the force on the thickness and conductivity of the cylinder and ring velocity is discussed. (auth)

15062 SECOND-ORDER APPROXIMATION OF ELECTRON TRAJECTORIES IN HIGH ENERGY RESOLUTION LINAC. Takeuchi, Y.; Fujioka, H.; Ura, K. (Osaka Univ., Suita, Japan). Part. Accel.; 6: No. 2, 77-82(1975).

For electron beams injected into a linac at the optimum injection phase, the energy variation at the exit plane depends on the variation of the injection energy to the first order, while it depends on the injection phase width and the transverse injection conditions to the second order. The systematic procedure is shown to make the second-order correction by aberration coefficients which are calculated from the direct integration of the second-order trajectory equations. It is proved that the invariance of the normalized longitudinal emittance extends to the second-order approximation for the axial electrons, provided that the relative variation of the injection energy is sufficiently smaller than that of the injection phase width. Finally, some numerical examples are given and discussed. (auth)

15063 GENERATOR OF A DENSE ATOMIC GAS CURTAIN. Zankel, K.; Vosicki, B. (European Organization for Nuclear Research, Dubna). J. Phys., E (London); 8: No. 5, 360-364 (May 1975).

A supersonic beam source is described which continuously generates a gas curtain for the proton beam profile observation in the Intersecting Storage Rings at CERN. Its maximum intensity is 10^{20} atoms/sr·s. A commonly used theoretical model for the determination of the intensity downstream of the source is discussed. Some results about the condensation behaviour of sodium vapour on metallic substrate surfaces are reported. (auth)

Storage Rings

15064 (RL-75-038) POWER SUPPLY FOR EPIC BOOSTER. Riedel, J. (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1975. 7p. (EPIC/MC-74). Dep. NTIS (US Sales Only) $4.00.

An alternate design is proposed for the power supply configuration for the NINA magnets when used as the guides for the EPIC booster synchrotron. This design is a simple and straightforward extension of the PPA (Princeton-Pennsylvania Accelerator) flat-topped magnet power supply scheme, and since the original NINA power supply scheme was almost identical to the original PPA design it is supposed that, as with the PPA flat-topping modification, the NINA configuration could easily be modified to duplicate the performance of the PPA flat-topping design. (auth)

15065 SYNCHROTRON RADIATION STUDIES OF THE *K*-EDGE PHOTOABSORPTION SPECTRA OF Kr, Br_2, AND $GeCl_4$: A COMPARISON OF THEORY AND EXPERIMENT. Kincaid, B.M. (W. W. Hansen Laboratories of Physics, Stanford University, Stanford, California 94305); Eisenberger, P. Phys. Rev. Lett. 34: No. 22, 1361-1364 (2 June 1975).

The *K*-edge photoabsorption spectra of Kr, Br in Br_2, and Ge in $GeCl_4$ were measured using synchrotron radiation from SPEAR, Stanford's e^+e^- storage ring, which provides a factor of 5×10^4 improvement in intensity over a conventional x-ray source. The agreement between theory and experiment is only qualitative. (auth)

Experimental Facilities

Refer also to abstracts 14398, 15885, and 16044.

15066 (AED-CONF-74-509-042) NEUTRON AND GAMMA RADIATION FIELD OF A DEUTERIUM GAS TARGET AT A COMPACT CYCLOTRON. Schraube, H.; Morhart, A.; Gruenauer, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H.,

Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). 1974. 23p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract.

The paper describes investigations in the uncollimated radiation field produced by the deuterium pressurized gas target at the compact cyclotron at the German Cancer Research Centre (DKFZ) in Heidelberg. In these studies dose rate and spectral distribution of fast neutrons were of particular interest as regards their use in depth therapy as well as the accompanying gamma component. The deuterons from the cyclotron was about 11 MeV, the maximum energy of the reacting deuterons after passing the target foil. For various operating conditions of the target, spectral distribution of fast neutrons was calculated at various distances from the target. On the basis of these spectral distributions several integral quantities were determined, e.g., kerma in tissue, in ionization chambers, as well as mean cross sections for some reactions used for neutron detection. (GE)

15067 (CEA-CONF-2953) EVOLUTION OF THE CHARACTERISTICS AND PERFORMANCES OF IMPLANTATION MACHINES. Guernet, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 29 Oct 1974. 37p. (In French). (CEA-LETI-ME-1053). INIS.

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974).

Instead of describing the components of the 200 or so existing heavy ion accelerators used for the implantation of ions this article concentrates on some important characteristics regarding the structures, ion sources, scanning systems and target chambers governing the industrial use of this technique. (FR)

15068 (GSI-J-2-74, pp 1-7) THE VELOCITY FILTER FOR HEAVY ION REACTION PRODUCT SIS. Ewald, H.; Guettner, K.; Hinckel, P.; Muenzerberg, G.; Faust, W. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

At the heavy ion accelerator the primary ions transmitted through a thin target should be separated from the reaction products by a focusing velocity filter combination. This led to symmetric arrangement of an electric field and two magnetic fields whereas quadrupole triplets serve as focusing elements. This apparatus is charge achromatic in position and direction and velocity achromatic in position only. (auth)

15069 (GSI-J-2-74, pp 8-12) THE HIGH FREQUENCY ELECTRIC DEFLECTING FIELD. Kankeleit, E.; Krueger, F. R.; Persson, B. I. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Beam guiding systems are reported which separate reaction products with defined velocity and phase by rf electric fields. (auth)

15070 (GSI-J-2-74, pp 60-64) OPTICAL PUMPING OF SHORT LIVING ALKALI ISOTOPES ON-LINE ON TRIGA-MAINZ. A Status Report. Cuerten, W.; Fellenberger, W.; Graef, H.; Hampel, I.; Kalepky, U.; Kaufman, S. L.; Kluge, H. J.; Kugler, L.; Minn, P.; Otten, E. W. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

A device for the construction of a target system for the optical pumping of short living alkali isotopes is described. A transfer system was constructed to lead the isotope into a resonance vessel to be optically pumped. The whole system is controlled by an on-line computer. (GE)

15071 (GSI-J-2-74, pp 65-69) WINDOWLESS GAS TARGET WITH SUPERSONIC FLOW. Gas-Dynamical Focussing of an Inert Gas Flow. Schopper, E.; Tietsch, W.; Feist, H.; Bethge, K. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

A gas target was constructed which consisted of a supersonic flow expanding into a gas atmosphere of several torr. Gasdynamic calculations show that a spatial focusing of the flow is possible by formation of compression shocks increasing the density in the focus. (GE)

15072 (GSI-J-2-74, pp 70-90) ANNUAL REPORT OF THE ASTERIX COLLABORATION. Georg, E.; Jung, W.; Matsuo, T.; Roebig, G.; Weitzel, W.; Wilhelm, H. G.; Wollnik, H.; Fleischer, H.; Kornahl, W.; Mazumdar, A. K. Nov 1974. (In German).

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the university groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

The present report is divided into nine themes beginning with the target up to the separator. The systematic investigation of the He-jet-transport method came to an end by the application of an aerosol generator. The work is now concentrated more and more upon a He-jet ion source separator system for the application at UNILAC. (auth)

15073 (GSI-J-2-74, pp 150-159) DEVELOPMENT AND APPLICATION OF SOLID TARGETS. Becker, H. J.; Boos, A. H.; Brandt, R.; Esterlund, R. A.; Habbestad-Waetzig, A. M.; Jungclas, H.; Molzahn, D.; Patzelt, P.; Reus, U.; Vater, P. Nov 1974. (In German).

2 figs.; 3 tabs.; 24 refs.

In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

The development and application of solid targets in heavy ion and proton reactions are described. The generation of superheavy elements by irradiating the targets is investigated. (GE)

15074 (NP-20343, pp 115-117) USE OF GLASS FRIT FOR THE REMOVAL OF RECOIL PRODUCTS FROM A TRANSPORT GAS. Kratz, J. V. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Liljenzin, J. O.; Silva, R. J. 15 Jun 1974. (In German).

In annual report, 1973.

15075 (NP-20343, pp 124-131) TARGET DEVELOPMENT. Burkard, K. H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Dumanski, W.; Kirchner, R.; Lauppe, W.; Otto, H.; Roeckl, E.; Seckert, F.; Weber, M. 15 Jun 1974. (In German).

In annual report, 1973.

15076 MOESSBAUER EXPERIMENTS WITHOUT CONVENTIONAL SOURCES. Ruby, S. L. (Argonne National Lab., Ill. (USA)). J. Phys. (Paris), Colloq.; No. 6, 209-211(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The high spectral density of radiation from high-energy synchrotron storage rings, and the possibility of its use as a source for Moessbauer measurements, is discussed. Dispersion in time, rather than energy, will be employed--the potential advantages are mentioned, but not the difficulties. (FR)

15077 NEUTRON GENERATOR. Breynat, G.; Dubus, M.; Fiat, G. (to CEA, 75 - Paris (France)). French Patent 2,213,635 /A/. 29 Dec 1973. 9p. (In French).

Description is given of a high flux high power neutron generator. That generatior comprises an ion accelerator tube provided at one end with a source of deuterium and tritium ions and at its other end with a target of hydridable metal, a high-voltage feed, means for pumping the deuterium-tritium mixtures so as to maintain a high vacuum within said accelerator tube, means for storing the extracted mixture, and means for adjusting the amount of tritium and deuterium extracted and re-injecting said mixture into the accelerating tube. (FR)

15078 APPARATUS FOR SIMULTANEOUS MEASUREMENTS OF THE POLARIZATION AND SPIN-ROTATION PARAMETERS IN HIGH-ENERGY ELASTIC SCATTERING ON POLARIZED PROTONS. Raoul, J. C.; Autones, P.; Auzolle, R.; Bruneton, C.; Bystricky, J.; Cozzika, G.; Deregel, J.; Ducros, Y.; Gaidot, A.; Katz, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Nucl. Instrum. Methods; 125: No. 4, 585-597(1 May 1975).

The main parts of an apparatus for simultaneous measurements of the polarization and spin-rotation parameters in high-energy elastic scattering on polarized protons are described, including the beam design, the polarized target, detectors, fast electronics, and the data acquisition. Measurements have been performed in 1972 to 1974 at the Serpukhov accelerator with π^-, K^- and $\bar{p}$ of 40 GeV/c, and with p, π^+ and K^+ of 45 GeV/c incident momentum. In addition to the results for P and R, the experiment also yields information on the unpolarized differential cross section. (auth)

15079 DEVELOPMENT AND PERFORMANCE OF A HIGH-CURRENT TRITIUM GAS TARGET. Mostafa, A. B. M. G. (Birmingham Univ. (UK). Dept. of Physics). Nucl. Instrum. Methods; 125: No. 4, 493-496(1 May 1975).

This paper reports the development and performance of a tritium gas target with special reference to the safety aspects. The target, 30 mm long and 20 mm in diameter, uses two pairs of windows cooled by helium gas circulated in a closed loop. The target can tolerate a 10.2 MeV proton beam of 15 μA at a gas pressure of 3 atm. The target has been extensively used with the Nuffield Cyclotron of the department for fast-neutron activation analysis. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

15080 (AD/A-000126) ASTRONAUTICS: ACHIEVEMENTS AND PROSPECTS. Glushko, V. 2 Oct 1974. Translated from Pravda, Moscow (USSR), No. 102, p. 3, 12 April 1974. (FTD-HC-23-2493-74). 11p. NTIS $3.25.

A brief discussion of what has been accomplished in the study of space and the prospects opening up in this field is presented. (GRA)

15081 FUNDAMENTAL INTERACTIONS IN PHYSICS AND ASTROPHYSICS. Conference Held at Coral Gables, Florida, January 19-21, 1972. Iverson, G.; Perlmutter, A.; Mintz, S. (eds.). Studies in the Natural Sciences, Volume 3. New York; Plenum Publishing Corporation (1973). 469p. (CONF-720114). $29.50.

Separate abstracts were prepared for the 20 papers presented. (JFP)

For abstracts of individual papers see: 15357, 15358, 15539, 15592–15594, 15610, 15636, 15637, 15670, 15690, 15704, 16066, and 16089–16095.

15082 DISTRIBUTION OF SPONTANEOUS FISSION FRAGMENTS IN NUCLEAR ASTROPHYSICAL PROBLEMS. Ohnishi, T. (Kyoto Univ., Uji (Japan). Inst. of Atomic Energy). Astrophys. Space Sci.; 34: No. 2, 321-345(May 1975).

Empirical equations for the estimation of fission fragment yield are proposed. These equations can be applied to all nuclides in the nuclidic region of $208 \lesssim A$ and $Z^2/A < 40.2$, and they can explain experimental results within an accuracy of 20%. By applying these empirical equations to nuclear astrophysics, the contribution of fission fragments to nuclidic abundance in the mass region of $100 \lesssim A \lesssim 170$ is estimated, in which mass region the fission fragments from fissioning nuclei with $A > 250$ accumulate. These nuclei with $A > 250$ are produced by r-process and make delayed spontaneous fissions during r-process cooling. Furthermore, a possibility is proposed that the anomalously high abundance of medium weight elements observed in some peculiar A stars may be the accumulation of the fission fragments from the fissioning nuclei in $250 \lesssim A \lesssim 265$. (auth)

Cosmic Radiation

Refer also to abstracts 15373, 15400, 15419, and 15619.

15083 (AD/A-000090) COSMIC RAY ASTRONOMY. Lipinsky, D. R. (United States Naval Academy, Annapolis, Md.). 21 May 1974. 124p. (USNA-TSPR-58). NTIS $5.25.

Time variations in the secondary cosmic ray flux may be attributed to two broad categories of effects: actual variations in the primary cosmic ray flux, and variations induced by changing conditions in the atmosphere. Mathematical simulations were developed to investigate the effects of changes in surface temperature and pressure upon a differential spectrum of muons with energies distributed about a muon energy of 400 MeV. The simulations involved considerable modelling of the production and propagation of the secondary muons. From the response of the simulation to changes in surface temperature and surface pressure, coefficients of temperature and pressure effects were determined. (GRA)

15084 (LBL-3675, pp 319-332) NUCLEAR SPALLATION OF COSMIC RAY NUCLEI IN THE INTERSTELLAR MEDIUM. Raisbeck, G. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). 1974.

In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Nuclear spallation of cosmic rays during propagation is qualitatively reviewed. After the problem is defined, a discussion is presented of the relevant information obtainable from studying nuclear reactions, specifically quantity and distribution of traversed matter, time and place of propagation, and source composition. Comments are offered on the cross sections and nuclear reactions that are critical for a complete understanding in this area. This is followed by a brief look at the present status of research and possibilities for further work using the Bevalac. (SDF)

15085 (LBL-3675, pp 333-348) ATOMIC CAPTURE AND LOSS CROSS SECTIONS OF RELATIVISTIC HEAVY IONS AND THEIR ROLE IN COSMIC RAY PHYSICS. Raisbeck, G. M. (Centre de Spectrometrie Nuclaire et de Spectrometrie de Masse, Orsay, France). 1974.

In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Heavy ion projectiles provide the possibility for elucidation of the mechanisms involved in atomic charge exchange as well as having important implications for the field of cosmic ray physics. A brief resume of the relevance of this subject to cosmic ray physics is followed by a discussion of some theoretical aspects of atomic charge exchange at very high energies and a look at the status of current experimentation. Direct application of these ideas to cosmic ray problems is discussed. (1 table, 8 figures) (SDF)

15086 (N-74-28272) SPACE RESEARCH IN THE UKRAINE. No. 3. Space Physics and Astronomy. May 1974. Translated from pp 1-111 of Kosmicheskie Issledovaniya na Ukraine, Vypusk 3, Fizika Kosmosai i Astronomiya, Naukova Dumka, Kiev, 1973. (NASA-TT-F-15537). 171p. NTIS $11.75.

Research is reported that includes: studies on cosmic rays; electromagnetic processes in the atmospheres of pulsars; ionospheric physics and the propagation of radio waves from space objects; electromagnetic processes in the earth's magnetosphere and their relationship with chromospheric flares; studies of the moon and the planets of the solar system using astronomical methods, and advances in methodology and instrumentation. For individual titles, see N74-28273 through N74-28285. (IAA)

15087 ZENITH-ANGLE DISTRIBUTIONS OF ATMOSPHERIC MUONS ABOVE 20 GeV. Decoster, R. J. (Univ. of California, Berkeley); Stevenson, M. L.; Toner W. T.; Zipf, T. F.; Breakstone, A.; Flatte, S. M. Lett. Nuovo Cim.; 12: No. 8, 239-245(22 Feb 1975).

A magnetic-spectrometer experiment has been performed at ground level with optical spark chambers, scintillator hodoscope trigger, and an air-gap magnet. Low energy results for $p < 300$ GeV are presented and zenith angles in the range $0.15 < \cos\theta < 0.6$ are covered with a total geometry factor of about 430 cm^2sr. Events representing a running time of $5.9 \cdot 10^5$s are reported. The number of particles above 20 GeV is 49062. It is noted that the rapid drop in the flux of low-energy particles at a large zenith angle is trivial due to the effects of energy loss in the atmosphere. (BJG)

15088 LOW-MOMENTUM MUON SPECTRUM NEAR THE EQUATOR. Allkofer, O. C.; Clausen, K.; Dau, W. D. (Kiel Univ.). Lett. Nuovo Cim.; 12: No. 4, 107-110(25 Jan 1975).

The same magnetic spark-chamber spectrograph is used to measure the vertical-momentum spectra of cosmic-ray muons in the range (0.3 + 26) GeV/c near the equator at sea level and at high altitudes (Kul spectra). Momentum intervals are identical for both data sets. From a comparison of the differential and integral equator spectra with the respective spectra at high altitudes, the latitude effect is deduced without any experimental bias. (BJG)

15089 ^{26}Al MEASUREMENTS IN STONE METEORITES AND ITS RELATION TO ORBITAL PARAMETERS AND COSMOGENIC PRODUCTION RATES. Top, Z. Fredericton, New Brunswick; Univ. of New Brunswick (1974). vp. National Library of Canada, Ottawa.

Thesis.

The cosmogenic Al^{26} activity has been measured by gamma-ray coincidence spectrometry in a total of 43 stony meteorites (19 hypersthene, 18 bronzite, 1 carbonaceous, 1 enstatite and 4 achondrites). The measured Al^{26} contents have been employed to calculate the aphelia of the orbits using the method developed by Lavrukhina and Ustinova. The model has been empirically modified to account for the difference in chemical composition between H- and L-chondrites. The great majority of the derived aphelia lie within the range 1.95-2.45 AU which is consistent with an asteroidal origin for the chondrites. The Al^{26} activities have also been used, along with the rare gas measurements of several workers, to derive the relative production rate R, of Al^{26} and Ne^{21} in ordinary chondrites. The variation of R with the degree of shielding has been established. (Diss. Abstr. Int., B)

15090 SOME UNUSUAL FEATURES OF THE COSMIC RAY STORM IN AUGUST 1972. Lockwood, J.A.; Hsieh, L. (Physics Department, University of New Hampshire, Durham, New Hampshire 03824); Quenby, J.J. J. Geophys. Res. 80: No. 13, 1725-1734 (1 May 1975).

The unusually large cosmic ray disturbance commencing on August 4 had three unusual features. First, a ground level event (GLE) was seen in neutron monitors at $P_c \lesssim 1.5$ GV beginning at about 1400 UT, almost 8 hours after the large solar flare at 0630 UT. This GLE can be attributed to relativistic solar particles that experienced coronal spreading onto flux tubes coming out toward earth and had a rigidity spectrum

for $0.7 \leqslant P \leqslant 2.0$ GV given by $7 \times 10^4 \ P^{(-8.5 \pm 1.0)}$ $(m^2\ s\ GV\ sr)^{-1}$. Second, a large precursory increase was associated with the rapid Forbush decrease (Fd) at 2100–2200 UT. This precursory increase resulted from a free space anisotropy of ~5% in magnitude, about 2 hours wide and in a direction 0°–30°W of the E-S line. Third, the Fd had a short time scale, with an overshoot in the initial recovery phase. These rapid cosmic ray intensity changes are related to the interplanetary field changes and a model proposed for this rapid Fd. (auth)

15091 SOLAR MODULATION OF GALACTIC COSMIC RAY ELECTRONS, PROTONS, AND ALPHAS. Fulks, G.J. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). J. Geophys. Res. 80: No. 13, 1701-1714 (1 May 1975).

Over the 5-year period 1968–1972 we have measured the energy spectrum of primary cosmic ray electrons from 20 MeV to 20 GeV using a balloon-borne absorption spectrometer. During the same period, other investigators have inferred the interstellar electron spectrum mainly from radio observations and have directly measured the electron spectrum at low energy, proton and alpha energy spectra, neutron monitor counting rates, radial particle gradients, the velocity of the solar wind, and the power spectrum of interplanetary magnetic field irregularities. Taken together these measurements constitute a wealth of data applicable to the problem of solar modulation. In this paper we present observations of the electron spectrum, examine the simple spherically symmetric model of modulation involving convection, diffusion, and adiabatic deceleration, and compare the model with the various measurements. Starting with electrons because some knowledge of the interstellar electron spectrum exists, we determine the rigidity dependence of the diffusion coefficient for each year, which will produce modulated electron spectra in agreement with observations. Then using the diffusion coefficient for 1 year to demodulate the observed proton and alpha spectra, we calculate modulated spectra for the other years and compare with observations. We find that the model is substantially capable of reproducing these observations above 40 MeV/nucleon. (auth)

15092 SOLAR COSMIC RAY 'SQUARE WAVE' OF AUGUST 1972. Medrano, R.A.; Bland, C.J.; Freeman, J.W.; Hills, H.K.; Vondrak, R.R. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). J. Geophys. Res. 80: No. 13, 1735-1743 (1 May 1975).

Three Rice University suprathermal ion detector experiments (Sides) were deployed on the lunar surface during the Apollo 12, 14, and 15 missions. During the exceptional period of solar activity in August 1972, penetrating particles were observed by all Side detectors on the night side of the moon. The penetrating particles are tentatively identified as solar protons with energies (~25 MeV or greater) that were able to penetrate the shielding of all detectors. Of particular interest is the occurrence on August 5 of a 'square wave' flux enhancement of 2-hour duration. Data from a variety of ground-based and space experiments are examined in relation to the square wave. Based on the results of this investigation a model relating the square wave to the flare plasma propagation is proposed. This model hypothesizes transport of energetic particles along a 'corridor' formed by the tangential discontinuity produced by the driver gas of a flare-induced shock wave. This model could explain other frequently observed delayed particle events. (auth)

15093 COSMIC RAY INTENSITY VARIATIONS DURING 0200–0700 UT, AUGUST 5, 1972. Venkatesan, D.; Mathews, T. (Department of Physics, University of Calgary, Calgary, Alberta, Canada T2N 1N4); Lanzerotti, L.J.; Fairfield, D.H.; Bostrom, C.O. J. Geophys. Res. 80: No. 13, 1715-1724 (1 May 1975).

A detailed investigation using interplanetary magnetic field measurements and particle data from ground-based neutron monitors, lunar sensors, and satellite-borne detectors has been made of the marked increase in cosmic ray intensity early on August 5, 1972. This enhancement was observed over the wide energy range 0.5 MeV to ~1 GeV and occurred during the recovery from the greatest recorded Forbush decrease. The increase at ~0300 UT on August 5 was in approximate coincidence with a decrease from ~40 to ~10 γ in the interplanetary field intensity and a change in the field direction from approximately radially outward to approximately radially inward. Sharp decreases in all particle fluxes occurred at about 0500 UT coincident with the increase in interplanetary magnetic field intensity from ~20 to ~40γ and a change in the field direction to radially outward. A detailed analysis of the neutron monitor data shows that the enhanced (~1 GeV) particle fluxes were not of solar origin. It is suggested that the enhancement occurs in a low-intensity interplanetary magnetic field bounded by tangential discontinuities, which connects to different particle sources both near the sun and in the outer solar system. The width of the regime was $\sim 3 \times 10^6$ km and resembled a magnetic well convected past the magnetosphere. The similarities in the structure of the event as observed by different detectors, the changes in the helium to proton ratios, the time delay of ~9 min between observations at Explorer 41 and those at the moon, and a north-south asymmetry in the enhancement observed by the neutron monitors are all explained in terms of this model. (auth)

15094 ON THE REQUIREMENTS FOR ACCELERATION MECHANISMS TO PRODUCE FLATTENED HEAVY PARTICLE COSMIC RAY ENERGY SPECTRA. Wayland, J. R. (Texas Agricultural and Mechanical Univ., College Station (USA)). Astrophys. Space Sci.; 33: No. 2, 459-463(Apr 1975).

The recently observed flattening of the energy spectra of high Z particles is investigated in terms of the limits it places on acceleration mechanisms. The possibility of a new mechanism is suggested. (auth)

15095 DIFFUSE COSMIC GAMMA-RAY BACKGROUND IN THE 28 keV-4.1 MeV RANGE FROM KOSMOS 461 OBSERVATIONS. Mazets, E. P.; Golenetskii, S. V.; Il'inskii, V. N.; Gur'yan, Yu. A.; Kharitonova, T. V. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Astrophys. Space Sci.; 33: No. 2, 347-357(Apr 1975).

Diffuse cosmic background and atmospheric gamma-radiation in the range 28 keV-4.1 MeV were studied with a scintillation spectrometer on board the Kosmos 461 satellite. Separation of the cosmic and atmospheric components was made possible through a reliable determination of the geomagnetic dependences of albedo gamma radiation. The spectrum of diffuse background in the energy range covered cannot be fitted with a common law. At energies below 400 keV the spectrum follows a power-law $I = (5.6 \pm 0.5) \times 10^{-3}\ E^{-(2.80 \pm 0.05)}$ $cm^{-2}\ s^{-1}\ sr^{-1}\ MeV^{-1}$. Starting from 400 keV, this power-law breaks down; the spectrum revealing a clearly pronounced shoulder. Extrapolation of the power-law spectrum to higher energies shows that the gamma-ray component responsible for the change in the shape of the spectrum is quite strong, becoming predominant in the diffuse background in the range 1 to 100 MeV. The intensity of excess radiation is maximum in the region of 700 to 800 keV reaching $\sim 1.8 \times 10^{-2}\ cm^{-2}\ s^{-1}\ sr^{-1}\ MeV^{-1}$. The shape of the high-energy component spectrum of the diffuse background constructed using the data of Kosmos 461 and SAS-2 is in agreement with the hypotheses of the cosmological origin of the radiation. (auth)

15096 POSSIBLE ASSOCIATION OF A HARD X-RAY SOURCE WITH A COSMIC GAMMA-RAY BURST. Biswas, S.; Manchanda, R. K.; Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay (India)). Astrophys. Space Sci.; 33: No. 2, L15-L18 (Apr 1975).

In this note, the possible association of the x-ray and γ-ray burst event of 7 October 1969 with the hard x-ray source observed with x-ray telescopes flown in balloons from Hyderabadin 1969 and 1970 is pointed out. The hard x-ray source, denoted as TWX-2 was observed and its spectral distribution was measured in the 15 to 150 keV integral in two balloon flights on 15 April 1969 and 5 May 1970 (Manchanda et al., 1972). The hard x-ray emission was found to originate in the region centered at $\alpha = 203°$, $\delta = 32°$ and having a width of 15° in R. A. and 18° in declination. It was noted that the hard x-ray emission from this region has anomalous spectra and these could come from more than one discrete source which were not resolved by the x-ray telescope. (auth)

15097 THE 1964–1972 QUIET-TIME SPECTRA OF PROTONS AND HELIUM AT 2–20 MeV PER NUCLEON. Zamow, R. (Enrico Fermi Institute). Astrophys. J. 197: No. 3, 767-780 (1 May 1975).

Studies of the differential spectra of protons and helium nuclei in the energy range 2–30 MeV nucleon^{-1} under interplanetary quiet-time conditions which were reported by this laboratory for the period 1964–1967 have been carried through the period 1967–1972 with the University of Chicago instruments on the IMP-4 and IMP-5 satellites. Although normally the fluxes below 20 MeV nucleon^{-1} are highly variable, indicating the dominance of a solar component, there are periods when the fluxes remain at a low and reasonably constant level. During these quiet periods the low-energy fluxes may still be fitted with "turnup" spectral forms proportional to $E^{-\gamma}$, with $\gamma \sim 2.8$. Since the data now span virtually an entire solar cycle, the long-term time-dependence of the spectra over solar cycle 20 has been determined. During the period 1964–1972, the variation of the fluxes is a factor ~7 and is similar to the modulation of the medium-energy cosmic rays. For example, when correlated with the Climax neutron monitor counting rate, the proton component exhibits a phase lag. The observed relative abundance of protons and helium is also closer to the medium-energy galactic than to the average solar-flare relative abundance. This evidence favors a galactic origin for the low-energy quiet-time turnup, although the possibility that a continually present solar or heliospheric acceleration mechanism could account for the observations cannot be ruled out. Analysis of the instrumental response and of the short-term variability of the low-energy turnup component proves that the component is not instrumental background due to higher-energy cosmic rays or electrons. (auth)

15098 COSMIC-RAY-PRODUCED ^{40}K AND ^{50}V IN THE METAL PHASE OF CHONDRITES. Imamura, K.; Shima, M.; Honda, M. (Tokyo Univ. (Japan). Inst. for Solid State Physics). Earth Planet. Sci. Lett.; 26: No. 1, 54-60(May 1975).

Cosmic-ray-produced ^{40}K in the metal phase of six chondrites and ^{50}V in that of one chondrite were determined using a surface ionization mass spectrometer. The $^{22}Ne_{tot}$-$^{40}K_{metal}$ ratios of the chondrites are explained in part by shielding effects during cosmic-ray irradiation. The wide variation of this ratio in some groups of meteorites is explained in terms of partial loss of rare-gas nuclides. Radiation ages for the chondrites were determined using ^{40}K measurements and production-rate estimates from thick target calculations. (auth)

15099 ANALYSIS OF GAMMA AND SYNCHROTRON RADIATION OF THE GALAXY AND THE ORGIN OF COSMIC RAYS. Shklovskii, I.S. (Institute of Cosmic Research, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 6, 677-679 (May 1975).

It is shown that the ratio of the powers of the energy losses of the proton-nuclear and electron components of cosmic rays in the galactic spiral arms has a value near the ratio of the energy densities of these components. This is explained by cosmic rays following with interstellar gas into the spiral arms, where they "perish," i.e., lose all their energy. The total power of the cosmic-ray sources in the Galaxy is estimated to be $\sim 2 \cdot 10^{39}$ erg/sec. It is argued that the few cosmic rays escape from the Galaxy. An indirect argument, based on energy considerations for relativistic particles in the remnants of supernova explosions, is adduced in favor of the idea that during such explosions many more relativistic protons are generated than relativistic electrons. It is pointed out that the electron cosmic-ray component is injected most likely by pulsars, whereas the proton-nuclear component may be generated in the shells of explosion remnants. However, this is not yet proved, and the most important task now is to discover a flux of hard gamma rays from remnants of supernova explosions, above all Vela-X. The absence of gamma radiation from the galactic spur means most likely that this object is not a remnant of a supernova explosion. (auth)

15100 MECHANISM OF FORMATION OF THE SPECTRUM OF THE ION COSMIC-RAY COMPONENT. Khakimova, M. (V. I. Lenin Tadzhik State University). Sov. Astron.—AJ 18: No. 6, 680-683 (May 1975).

A mechanism of formation of the ion distribution function of cosmic rays in the cosmic-ray sources is considered. The time required to establish a power spectrum of the ions as a result of interaction with cosmic-ray electrons is estimated. The mechanism is effective only when the density of cosmic rays is sufficiently high, i.e., in the cosmic-ray sources but not in interstellar space. (auth)

15101 A TIME-DEPENDENT DIFFUSION-CONVECTION MODEL FOR THE LONG-TERM MODULATION OF COSMIC RAYS. O'Gallagher, J.J. (Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 197: No. 2, 495-507 (15 Apr 1975).

Incorporation of the effects of time-dependent diffusive propagation of galactic cosmic rays inside a modulating region whose basic parameters are slowly changing in time leads to a new prediction for the modulated density $U(t)$ expected to be observed at a given time. A first-order perturbation analysis shows that if $U_s(t_0)$ is the expected density under completely stationary conditions at time t_0, then the actual density under slowly varying conditions will be given by $U(t_0) = U_s[t_0 - \tau(K)]$, where $\tau(K)$ is the average time spent by a particle of diffusion coefficient K inside the modulation region. An analysis of the behavior of τ as a function of various modulating parameters in both an idealized one-dimensional convective wind and a three-dimensional radial wind shows that τ can be greater than 100 days under reasonable values of these parameters. The general behavior is such that in a modulating region characterized by the distance to the modulating boundary R, the convective velocity V, and K, the average time τ is proportional to R^2/K in the limit of large K and R/V in the limit of small K for both geometries. This general behavior is not appreciably affected by energy loss processes. Since τ is a function of K which is in turn a function of magnetic rigidity R and velocity β, this model provides a natural physical explanation for observed rigidity-dependent phase lags in modulated spectra sometimes referred to as cosmic-ray "hysteresis." If all of the phase lag observed between 500-MeV protons and the Deep River neutron intensity is attributed to the effects described here, the average distance to the modulating boundary during the last solar cycle is estimated to be 45-55 AU. (auth)

15102 ENERGY DEPENDENCE OF THE Si/Fe RATIO IN THE GALACTIC COSMIC RAYS. Garcia-Munoz, M.; Juliusson, E.; Mason, G.M.; Meyer, P.; Simpson, J.A. (Enrico Fermi Institute, University of Chicago). Astrophys. J. 197: No. 2, 489-493 (15 Apr 1975).

Recent measurements by Israel *et al.* and Webber have indicated that the silicon-to-iron ratio in the galactic cosmic radiation increases rapidly with decreasing energy over the range ~0.4 to 1 GeV per nucleon. Measurements made with the University of Chicago instrumentation on satellites and high altitude balloons over the energy range 35 MeV to 4 GeV per nucleon do not support this result. The measurements reported here leave only a small gap in the range of the Israel *et al.* and Webber measurements, therefore restricting a large variation of the Si/Fe ratio to a narrow energy range. Our data show little variation in the Si/Fe ratio below 1 GeV per nucleon, and are consistent with energy independence over this energy range. Energy spectra for Si and Fe are presented, and the corresponding local interstellar spectra are calculated using a standard model of solar modulation. It is found that the local interstellar spectra can be fitted by current models of galactic propagation. (auth)

15103 THE SPECTRUM OF COSMIC ELECTRONS WITH ENERGIES BETWEEN 6 AND 100 GeV. Meegan, C.A.; Earl, J.A. (Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 197: No. 1, 219-233 (1 Apr 1975).

This experiment was carried out during three balloon flights which provided a total exposure of 3500 ± 60 m^2 s sr at an average depth of 4.8 g cm^{-2}. The detector, in which the development of cascade showers in a 33.7 radiation lengths absorber was sampled by 10 scintillation counters and 216 Geiger–Müller tubes, was calibrated at the Cornell Electron Synchrotron. The separation of cosmic electrons from the nuclear background was confirmed by extensive analysis of data from the flights, from the calibration, and from a ground level exposure. The spectral intensity of primary cosmic-ray electrons in particles m^{-2}s^{-1} sr^{-1} GeV^{-1} was found to have the following power-law dependence upon the electron energy E in GeV: $dJ/dE = (800 \pm 60)\, E^{-3.4 \pm 0.1}$. Similarly, the ground level spectrum of secondary cosmic-ray electrons was found to be $dJ/dE = 1.1 E^{-2.9 \pm 0.1}$. The steepness of the spectrum of cosmic electrons relative to that of nuclei implies one of the following conclusions: either the injection spectrum of electrons is steeper than that of nuclei, or the electron spectrum has been steepened by Compton/synchrotron losses in the energy range covered by the experiment. (auth)

Stars

Refer also to abstracts 15205, 15213, 15215, 15234, 15238, 15295, 15316, 15344, 15370, 15403, 15429, 15650, and 16156.

15104 (LBL-3675, pp 307-317) HIGH ENERGY REACTIONS IN NUCLEOSYNTHESIS. Truran, J. W. (Univ. of Illinois, Urbana). 1974.

In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

High energy reaction mechanisms are directly responsible for the formation of a number of lighter nuclei in astrophysical environments. They are very likely responsible as well for the anomalous abundance features observed in the spectra of "peculiar" stars and for the synthesis of some heavy nuclei in supernova shock waves. Their most important contribution to nucleosynthesis may ultimately prove to be an indirect one—that of allowing the disintangling of the cosmic ray abundances to provide detailed information concerning the nature of cosmic ray sources. A brief review of these various problems is presented. (37 references) (auth)

15105 (UCRL-76376) OBSERVATORY REPORT. Tarter, C. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1975. 12p. (CONF-750427-1). Dep. NTIS $4.00.

From meeting of the American Physical Society; Washington, District of Columbia, USA (28 Apr 1974).

Astrophysical and astronomical research at the Lawrence Livermore Laboratory during 1974 is summarized. Topics include stellar structure, supernovae, nucleosynthesis, nebulae and the interstellar medium, observational x-ray astronomy, theoretical high energy astrophysics and related research. (BJG)

15106 SCALAR PARTICLE PRODUCTION IN SCHWARZSCHILD AND RINDLER METRICS. Davies, P. C. W. (King's Coll., London). J. Phys., A (London); 8: No. 4, 609-616(Apr 1975).

The procedure used recently by Hawking (Commun. Math. Phys. to be published) to demonstrate the creation of massless particles by black holes is applied to the Rindler coordinate system in flat space-time. The result is that an observer who undergoes a uniform acceleration κ apparently sees a fixed surface radiate with a temperature of $\kappa/2\pi$. Some implications of this result are discussed. (auth)

15107 FG SAGITTAE. The Star Which Changes in Brightness, Temperature, and Element Composition. Nissen, P. E. (Aarhus Univ., Denmark). Astron. Tidsskr.; 7: No. 4, 160-162(1974). (In Danish).

FG Sagittae has since 1890 increased its brightness 40 times, while since 1955 its surface temperature has fallen from 20,000

to 6,000°K. Recent spectral analyses show that the element composition in its atmosphere has changed radically between 1967 and 1972. The increased brightness together with falling temperature indicates rapid expansion. The thermal type has changed from B4Ia (blue supergiant) to AOIa, A5Ia, FOIp and F6Ip between 1955 and 1972. Its distance was deduced to be 8,200 light years. Spectral analyses show that the samarium, lanthanum, cerium, zirconium and barium lines became stronger between 1969 and 1972. This can be explained by the nuclear s-process occurring in the star's interior. It is possible that FG Sagittae is in the process of becoming a red giant. (JIW)

15108 POSITIVELY CHARGED ISOSPIN WAVE SOFTENING AND PROTON LATTICE IN NEUTRON STARS. Anderson, P. W. (Bell Labs., Murray Hill, NJ); Itoh, N.; Alpar, M. A.; Tosatti, E.; Palmer, R. B. Lett. Nuovo Cim.; 12: No. 6, 165-170(8 Feb 1975).

Isospin may carry excitations in a dense medium of nucleons like neutron-star matter. An isospin wave results from π-mesons and a coupling of excitations of the medium with the same quantum numbers as a π-meson to the π-meson. Softening of the isospin wave occurs when a phase transition takes place in the nucleon medium to a system in which there is a condensation of such excitations. To explain experimentally observed electron scattering cross sections, a co-operative relationship between isospin waves and crystallization of neutron star matter is suggested. Phase transitions in neutron stars should be looked at in terms of $I_Z = {}^+1$ (π^+ condensation) rather than $I_Z = {}^-1$ (π^- condensation). Essential instability need not necessarily occur in the (-) mode since low-energy charged excitations exist for either sign of charge. Softening is considered in a neutron-rich medium, and coupling of π-mesons to particle-hole excitations is discussed. It is noted that a branch that goes soft within the pair excitation region is well defined at the condensation point, implying instability for the system. Experiments show only $I_Z = +1$ condensation is physical. Consequences are discussed. (BJG)

15109 ESTIMATE OF THE AGE OF THE CLUSTER α PER. Zakharova, P. E.; Svechnikov, M. A. (Urals State Univ., Sverdlovsk, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 82-83(1973).

Translated from Astrofizika; 9: No. 1, 147-150(1973).

The total mass of stars on the main sequence in a stellar cluster per unit interval of the logarithm of the mass yields information on the beginning and ending of star formation in a given cluster. Plots for the cluster α Per of total mass against the time a star remains on the main sequence and log total mass against log Δt enable the approximate estimate of two values for the time of the end of star formation which are in agreement. Data of UBV photometry for 187 possible members of the α Per cluster provides verification on the cluster's age. (BJG)

15110 DEPENDENCE OF THE TOTAL MASS OF STARS IN UNIT VOLUME ON THE TIME OF THEIR EVOLUTION. Zakharova, P. E.; Svechnikov, M. A. (Urals State Univ., Sverdlovsk, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 79-81(1973).

Translated from Astrofizika; 9: No. 1, 143-147(1973).

The star formation function per unit interval of logarithm of the masses can be determined from the luminosity function in the neighborhood of the sun. Calculations show the star formation function calculated for unit mass interval is proportional to $1/M^2$. Plots reveal the dependence of the total mass of matter in unit volume per unit interval of logarithm of the masses on the time that stars of given mass stay on the main sequence. The time at which star formations begin, ceased, and slowed can be estimated for given star clusters from reliably determined luminosity functions. The cluster NGC 6866 is investigated. (BJG)

15111 ACCELERATION OF PULSARS TO HIGH VELOCITIES BY ASYMMETRIC RADIATION. Tademaru, E.; Harrison, E. R. (Univ. of Massachusetts, Amherst). Nature (London).; 254: No. 5502, 676-677(24 Apr 1975).

It is proposed that pulsars are accelerated by the emission of asymmetric low frequency electromagnetic radiation, and an expression is derived for the velocity of a pulsar as a result of this emission. Velocities > 100 km/sec may be rapidly attained. Although pulsars are probably born in binary systems the radiation reaction force is initially strong enough to wrench apart all but the closest binaries, thus explaining why most pulsars are not members of binary systems. There is evidence suggesting that the oblique dipole rotator model for pulsars is oversimplified, and recent studies of magnetic variable stars have shown that an inclined magnetic dipole moment, displaced from the rotation axis, provides an improved model for reproducing the surface field. Consideration is given to a pulsar with a magnetic dipole moment that is arbitrarily oriented and also displaced from the rotation axis. (UK)

15112 IS CIR X-1 A RUNAWAY BINARY. Clark, D. H.; Parkinson, J. H.; Caswell, J. L. (University Coll., London). Electron. Lett.; 254: No. 5502, 674-676(1 May 1975).

It is stated that runaway stars are produced when there is a supernova explosion in a close binary system. Such an explosion usually disrupts the binary system, but is was a suggested that sometimes the collapsed residue from the explosion may be retained in orbit around the runaway star, the resulting system being a binary with high eccentricity and large space velocity. It is suggested here that Cir X – 1 represents such a system. A 408-MHz radio map of the Cir X – 1 region is shown, centered on the recently discovered supernova remnant SNR G321.9-0.3. The question is discussed as to whether Cir X – 1 and the latter are related, and in particular, is Cir X – 1 a runaway system ejected from the supernova. It is concluded that the properties of Cir X_{-1} are compatible with its being a runaway binary at a distance of ~ 5 kpc and of an age ~ 10^4 to 15^5 yr (the estimated age of the SNR) and that the available data for Cir X – 1 are not inconsistent with its being at the distance of the SNR (5.5 kpc). This is considered to be the first SNR-binary system association to be discovered and gives credibility to theories suggesting that supernovae have given rise to all the close binary systems, if not all the galactic x-ray sources. (UK)

15113 COMETS AND INTERSTELLAR MASERS. Oppenheimer, M. (Harvard Coll. Observatory, Cambridge, MA). Nature (London).; 254: No. 5502, 677-678(24 Apr 1975).

It is suggested that long period comets are among the condensed remnants of cooled interstellar masers formed in a dense region at the primordial solar nebular boundary, and the dynamics of maser-comet transitions are discussed. Ways in which this relation may be exploited to expand an understanding of star and planet formation are indicated. Sources of maser radiation are discussed. The elevated temperatures needed to produce masers are obtained in or near protostellar objects and young stars, and the thermal evolution of maser sources that lie on the edge of the nebula of a new star is considered. (UK)

15114 CONVECTIVE ENVELOPES AND COOLING OF DEGENERATE DWARFS. Sweeney, M. A. New York; Columbia Univ. (1974). 176p. University Microfilms Order No. 74-29,669.

Thesis (Ph. D.).

The energy content and thermal structure of degenerate dwarfs is studied for a wide range of masses, luminosities and envelope compositions. The relative importance of different treatments of pressure ionization, crystallization, specific heat, and opacity and of mass, luminosity, and chemical composition in determining the ages is investigated. It is demonstrated that the usual procedure of calculating the adiabatic gradient in high pressure regions leads to violation of the Maxwell identities of corresponding changes are not made in the entropy and pressure of the gas. As a result of most of the effects considered in this investigation, it was found that convection plays a smaller role in determining the envelope structure and central temperature than previously assumed. The cooling time at low luminosities is maximum at a mass of about 0.9 solar mass. All degenerate dwarfs with interiors composed of carbon or heavier elements cool to invisibility in less than 8×10^9 years. (BJG)

15115 REFLECTION EFFECT IN CLOSE BINARY SYSTEMS. Vanlandingham, F. G. Bloomington, IN; Indiana Univ. (1974). 176p. University Microfilms Order No. 75-1767.

Thesis (Ph. D.).

The investigation studies the effects of the irradiation of the hotter component in a close binary system on the atmosphere of the secondary and on the observed flux distribution of the binary system. An existing model atmospheres computer program is modified to include the effects of non-zero incident radiation. Computations reveal that the irradiation can significantly raise the temperature in the upper layers of the atmosphere. (BJG)

15116 TEMPERATURE, GRAVITY, AND METAL ABUNDANCE CALIBRATION OF THE UVBY PHOTOMETRIC SYSTEM AND ITS APPLICATION TO BLUE HORIZONTAL-BRANCH STARS. Matlock, L. T. Albany; State Univ. of New York (1974). 221p. University Microfilms Order No. 75-1566.

Thesis (Ph. D.).

Theoretical uvby indices are computed from hydrogen-line-blanketed model atmospheres as functions of theta/sub e/ and log g for 0.40 less than or equal to theta/sub e/ less than or equal to 0.70 and 2.0 less than or equal to log g less than or equal to 4.0. Values of theta/sub e/, log g, and y/sub bol/ are derived for 19 blue horizontal-branch stars in the globular cluster NGC 6397 and the masses of the stars are computed. At least three

possible conclusions can be drawn from this analysis: (1) a mass dispersion of 0.5 solar mass exists on the blue horizontal-branches of some globular clusters, (2) nonstellar contributions to the ubvy indices are masking the true stellar indices of some blue horizontal-branch stars, and (3) the emergent flux of some blue horizontal-branch stars is influenced by some stellar parameter whose effect on the ubvy indices has not been considered or has been underestimated. (BJG)

15117 X-RAY SOURCES AND THEIR OPTICAL COUNTERPARTS. III. Jones, C.; Forman, W.; Liller, W. (Harvard and Smithsonian Astrophysical Observatories, Cambridge, MA). Sky Telesc.; 49: No. 1, 10-13(Jan 1975).

The properties of various x-ray sources are discussed; also the two competing models to explain the Perseus cluster's x-ray emission, the brightest known QSO, and prospects for the new x-ray satellite, HEAO-B are covered. (JFP)

15118 MAGNETIC FIELD AND SCREENING EFFECTS IN CONDENSED AND ULTRADENSE MATTER. Roussel, K. M. Baton Rouge, LA: Louisiana State Univ. (1974). 209p. University Microfilms Order No. 75-1951.

Thesis (Ph. D.).

The investigations of three topics are presented: (1) the origin of magnetic fields in white dwarfs and neutron stars, (2) the detection of magnetic fields in white dwarfs, and (3) screening effects due to free charged particles, particularly in semiconductors. (auth)

15119 CHEMICAL COMPOSITION AND EFFECTIVE TEMPERATURES OF METALLIC LINE WHITE DWARFS. Hammond, G. L. College Park, MD: Univ. of Maryland (1974). 120p. University Microfilms Order No. 74-29,764.

Thesis (Ph. D.).

Model atmosphere techniques have been employed to determine the composition, effective temperatures, radii, masses and surface gravities of white dwarfs Ross 640 and van Maanen 2. The non-gray, LTE, convective, constant flux models employed collisional damping constants for the Ca II H and K lines that were measured in a laboratory device that simulated white dwarf atmospheric conditions. Ross 640 was found to have an extremely helium-rich composition and T/sub eff/ equals 8500K, while the observed properties of van Maanen 2 were fitted best by a model with 91 percent helium, 9 percent hydrogen and T/sub eff/ equals 6100K. The laboratory measurements of pressure shifts for the Ca II lines casts some doubt on the interpretation of recent radial velocity determinations for van Maanen 2. (Diss. Abstr. Int., B)

15120 VARIABLE X-RAY SOURCE NEAR CEN X-3. Eyles, C. J. (Univ. of Birmingham, Eng.); Skinner, G. K.; Willmore, A. P.; Rosenberg, F. D. Nature (London); 254: No. 5501, 577-578(17 Apr 1975).

Some observations are reported on the Centaurus region from the satellite Ariel V, launched in October 1974. This carries a rotation modulation collimator experiment designed to measure the positions of x-ray sources, responding to x-rays in the energy range 3.1 to 9.3 keV. The region investigated included the important binary source Cen X-3. A new weak source was indicated, not listed in the Uhure (3U) catalog. This source was designated A1118-61. It is possible that the observed event was a rather strong flare of the kind observed in Sco X-1; on the other hand the x-ray light curve strongly resembled that shown by some moderately fast novae. Short period fluctuations were observed, and a position was obtained for the source. Although the x-ray emission may now have decayed below the value first observed, it is suggested that optical observation of possible candidate stars may be worthwhile. (UK)

15121 OBSERVATIONS OF A TRANSIENT X-RAY SOURCE WITH REGULAR PERIODICITY OF 6.75 MIN. Ives, J. C.; Sanford, P. W.; Burnell, S. J. B. (Mullard Space Science Lab., Dorking, Eng.). Nature (London).; 254: No. 5501, 578-580(17 Apr 1975).

During observations of the x-ray source Cen X-3 from the satellite Ariel V, which carried a collimated proportional counter, a previously unreported nearby source was observed, and was monitored for 39 days in December 1974 to January 1975. Measurements of the light curve and spectrum are reported, together with a regular variability of about 6.75 min. The first observations indicated a weak source of 0.006 photon cm^{-2} s^{-1} keV^{-1} in the energy range 3 to 30 keV. The intensity then increased to 0.02, followed by decay to 0.004. The data were best fitted by a power law spectrum rather than by an exponential or blackbody spectrum, although no such simple model spectrum satisfactorily describes the data. There appeared to be significant absorption from material local to the source. Combining all the data allowed, the period is refined to 6.755 ± 0.010 min. It is considered that the periodicity is a constant characteristic of the source and not a transient periodicity associated with a flare. Possible explanations for the periodicity are discussed. (UK)

15122 PULSATING STARS. Percy, J. R. Sci. Am.; 232: No. 6, 67-75(Jun 1975).

A discussion of variable stars is given. The stars are monitored in order to learn the nature and evolution of stars. Various properties of these stars are included in the discussion including the mass, observable properties, variability, pulsation and equilibrium, relation between period and luminosity, the Eddington theory, a pulsating star model, and the nonlinear approach. (JFP)

15123 HOW TO MAKE METAL-POOR STARS, REDDEN OB ASSOCIATIONS AND GROW MANTLES ON GRAINS. Edmunds, M. G.; Wickramasinghe, N. C. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 34: No. 1, 131-136(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Three consequences of the existence of grains with metal-rich ice mantles are considered: (i) The production of metal-poor stars by expulsion of protostellar grains by radiation pressure during star formation. (ii) The effects of these expelled grains in reddening massive stars in an OB association. (iii) The production of the icy mantles on grains in OB associations. (auth)

15124 POLARIZATION PROPERTIES OF SILICATE-LIKE GRAINS IN CIRCUMSTELLAR ENVELOPES OF LATE-TYPE STARS DUE TO TEMPERATURE VARIATIONS. Svatos, J.; Solc, M.; Vanysek, V. (Karlova Universita, Prague (Czechoslovakia)). Astrophys. Space Sci.; 34: No. 1, 149-154(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

The influence of temperature changes in circumstellar silicate-like envelopes upon the polarization effects is investigated. It is shown that under the assumption that $\Delta T_g > 50°$ and conductivity of silicate grains is indirectly proportional to T_g this mechanism can be responsible for the observed dependence of intensity vs polarization in some late-type stars, e.g. V CVn. The same effects can be produced by dirty ices and graphite grains. It is suggested that irradiation by electrons and/or protons can affect the circumstellar envelopes in a similar way, especially those of early-type stars, and irradiation by neutrons can exert an influence on the envelopes of supernovae. (auth)

15125 SOLID STATE PHYSICS AND COOLING OF NEUTRON STARS. Tsuruta, S. (Sussex Univ., Brighton (UK)). Astrophys. Space Sci.; 34: No. 1, 199-208(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

First the possible effect of the "magnetic" condensation on cooling of neutron stars is shown. Its observational significance (especially for younger pulsars such as the Crab pulsar) is emphasized. Other effects of solid state physics on cooling are also discussed. (auth)

15126 NEUTRON STAR CORES. Palmer, R. G. (Princeton Univ., N. J. (USA). Dept. of Physics). Astrophys. Space Sci.; 34: No. 1, 209-222(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Current theories, and the astrophysical implications, of the nature of high-density neutron star matter are reviewed. Suggestions are made for a compromise between the alternatives of neutron crystallization and pion condensation. (auth)

15127 STRUCTURE OF NEUTRON STAR CORES. Canuto, V. (National Aeronautics and Space Administration, New York (USA). Goddard Inst. for Space Studies); Datta, B. (City Coll., New York (USA). Dept. of Physics); Lodenquai, J. (West Indies Univ., Kingston (Jamaica). Dept. of Physics). Astrophys. Space Sci.; 34: No. 1, 223-229(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

After reviewing the outer and central regions of a neutron star, the central region and the possibility that the core has a solid structure are discussed. The work of different groups on the solidification problem is presented which suggests that the neutron star-cores are indeed solid. (auth)

15128 THERMAL EMISSION SPECTRA OF SILICATES FROM PLANETARY NEBULAE. Bussoletti, E. (Lecce Univ. (Italy). Istituto di Fisica); Baluteau, J. P.; Epchtein, N. (Observatoire de Paris, Section de Meudon, 92 (France)). Astrophys. Space Sci.; 34: No. 1, 81-89(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Calculations of the grain equilibrium temperature and of the expected infrared spectra of IC 418, BD + 30° 3639, NGC 6572, and NGC 7027 have been performed using dielectric constants of lunar silicates. The results have been compared with previous work on pure graphite and ice-mantle grains. Lα heating of dust followed by thermal re-emission is consistent with the large infrared excesses detected in planetary nebulae. An extra source of heating is, nevertheless, necessary to fit correctly the experimental results. It appears from the calculations that, for each object, it is possible to define theoretically the most probable nature of the emitting dust. (auth)

15129 NEUTRAL CURRENTS AND THE COOLING OF NEUTRON STARS. Chitre, S. M.; Narlikar, J. V.; Ramadurai, S. (Tata Inst. of Fundamental Research, Bombay (India)). Astrophys. Space Sci.; 33: No. 2, L45-L47(Apr 1975).

Although the neutrino cooling rate by purely leptonic processes is altered by the neutral currents, the overall cooling of model neutron stars is shown to remain practically unaffected. (auth)

15130 THE RADIATION FIELD IN PHOTOSPHERIC MODELS FOR EXTREME SUPERGIANTS. de Jager, C. (The Astronomical Institute, Utrecht, Holland); Neven, L. (Royal Belgian Observatory, Brussels, Belgium). Astrophys. Space Sci.; 33: No. 2, 295-323(Apr 1975).

On the basis of assumed photospheric temperature models for 36 extreme supergiants (log g_e-values of 1, 0.5 and 0; T_e ranging from approx. 3700 to 33,000 K) photospheric fluxes $S(\tau_\lambda)$ were computed for 36 wavelengths ranging from 100 to 60,000 Å. The hot models are in perfect radiative equilibrium; the cooler show deviations up to 10%, sometimes even larger. Only in the relatively deep parts of the photospheres ($\tau_5 \gtrsim 1$) the radiation field at each geometrical level can be characterized by one unique radiation temperature; for smaller τ_5-values there are large deviations from local thermal equilibrium. The influence of deviations from local thermodynamical equilibrium on fluxes is briefly examined and appears small but for the shortest wavelengths. In tables and graphs for these models $\pi F(\lambda)$-values, integrated fluxes, effective temperatures, colours U, B and V, and the Balmer discontinuity D are given. (auth)

15131 ON THE ORIGIN OF NOVA-LIKE BINARY SYSTEMS. Gorbatsky, V. G. (Leningradskij Gosudarstvennyj Univ. (USSR)). Astrophys. Space Sci.; 33: No. 2, 325-332(Apr 1975).

Nova-like binary systems are similar to W UMa-systems in their basic physical characteristics. Outwardly such systems are different—nova-like systems contain a white dwarf as a component while both components of a W UMa-system are near the main sequence. A hypothesis is proposed, seeking the origin of contact W UMa-type systems in a fission of a rapidly-rotating helium isothermal core of an evolved giant star. The contraction of the more massive component leads to the formation of a white dwarf and, consequently, to a transformation of a W UMa-type system into a nova-like system. (auth)

15132 FREE-FREE OPACITY OF DENSE STELLAR MATTER. De Zotti, G. (Padua Univ. (Italy). Istituto de Astronomia). Astrophys. Space Sci.; 33: No. 2, 359-367(Apr 1975).

A nonrelativistic calculation of the free–free opacity is made in detail for the conditions of intermediate and strong electron degeneracy. Corrections to the Born approximation are included and the ion correlations as well as the electron screening of the nuclear charge are taken into account. The free–free opacity is compared with the conductive one. It is shown that it must be taken into account when the degeneracy is not too strong, that is in the temperature–density regime where the plasma frequency, ω_p, satisfies the condition $\omega_p \lesssim 2.5$ kT. (auth)

15133 COMPUTER SIMULATIONS OF GAS FLOW AROUND CLOSE BINARY SYSTEMS. Soerensen, S. A.; Matsuda, T.; Sakurai, T. (Kyoto Univ. (Japan). Faculty of Engineering). Astrophys. Space Sci.; 33: No. 2, 465-480(Apr 1975).

A gas-dynamical model of gas streams around close binary systems is given. The velocity field and the density distribution are determined for different parameter ranges. The results succeed in explaining the formation of a ring and a disk around the accreting component. The models furthermore reveal the existence of a tongue of matter extending from the inner Lagrangian point and a jet perpendicular to the system axis. (auth)

15134 SIX-COLOR OBSERVATIONS OF ALGOL, 1949–1951. Stebbins, J.; Gordon, K. C. (Lick Observatory, Mount Hamilton, California, USA). Astrophys. Space Sci.; 33: No. 2, 481-486 (Apr 1975).

Observations of Algol in six colors, covering both eclipses, are presented. Primary minimum occurred at JD 2433 228.8684. (auth)

15135 DUPLICITY OF SOME T TAURI STARS AND RELATED VARIABLES. Romano, G. (Padua Univ. (Italy). Istituto di Astronomia). Astrophys. Space Sci.; 33: No. 2, 487-490(Apr 1975).

A number of double stars of which at least one component is a T Tauri star or related variable were measured in three fields: φ and χ Tauri (Taurus dark cloud); NGC 7023, and NGC 2264. (auth)

15136 MASS AND STABILITY OF RIGIDLY ROTATING RELATIVISTIC POLYTROPES BY ENERGY METHOD. Van Riper, K.A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Ann. Phys. (N.Y.) 90: No. 2, 530-572 (Apr 1975).

The energy of a rigidly rotating star is written in the first and second post-Newtonian approximation. Conditions for equilibrium and stability are derived, as well as evolutionary paths for stars shedding angular momentum or mass. For polytropic index $n > 1$, these analytic results agree with exact numerical results to within a few percent as long as the general relativity index $(P/\rho c^2)_c < 0.1$. The energy method is applied to low mass white dwarfs, to semirelativistic neutron stars and to supermassive stars. (auth)

15137 BINARY O STAR HR 8281. Crampton, D.; Redman, R.O. (Dominion Astrophysical Observatory, Victoria, British Columbia, Canada). Astron. J. 80: No. 6, 454-457 (June 1975).

Recent high-dispersion spectroscopic observations of HR 8281 establish the presence of the spectrum of a secondary companion. The system appears to be composed of an O6 and O9 star of normal mass and hence it is unlikely that it is related to the x-ray source Cep X-4. (auth)

15138 1612-MHz SURVEY OF M SUPERGIANTS. Bowers, P.F. (Astronomy Program, University of Maryland, College Park, Maryland 20742). Astron. J. 80: No. 7, 512-514 (July 1975).

A total of 66 M supergiants have been surveyed for OH emission at 1612 MHz. One new source, S Per, has been detected and is the fifth known supergiant OH/IR star. It is suggested that supergiant OH/IR stars are a small percentage ($\lesssim 10\%$) of the M-supergiant population. (auth)

15139 OSCILLATOR STRENGTHS AND EXCITED-STATE LIFETIMES IN THE SODIUM SEQUENCE. Laughlin, C.; Lewis, M.N.; Horak, Z.J. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 197: No. 3, 799-804 (1 May 1975).

A first-order Z-expansion method is used to calculate oscillator strengths and radiative lifetimes in the sodium sequence. The computed $3s$-$3p$ and $3p$-$3d$ oscillator strengths for the more highly ionized members of the sequence are generally in satisfactory agreement with the experimental values. Lifetime results for $4p$ and $4d$ states of sodium-like ions are presented graphically in a manner which demonstrates their regularity as a function of Z^{-1} and allows interpolation to be carried out. (auth)

15140 EXPERIMENTALLY DETERMINED ABSOLUTE OSCILLATOR STRENGTHS OF Ti I, Ti II, AND Ti III. Roberts, J.R.; Voigt, P.A. (Institute for Basic Standards, National Bureau of Standards); Czernichowski, A. Astrophys. J. 197: No. 3, 791-798 (1 May 1975).

Absolute oscillator strengths of Ti I, Ti II, and Ti III transitions in the wavelength region from 2440 Å to/3500 Å have been experimentally determined using a wall-stabilized arc. Titanium in the form of heated $TiCl_4$ was admixed with argon plus 5 percent H_2 and introduced into the arc, which was operated at a current of 40–60 amperes. Axis temperatures and electron densities ranged from 11,000 K to 12,500 K and 3.5×10^{16} cm^{-3} to 8.7×10^{16} cm^{-3}, respectively. (auth)

15141 ANALYTIC SURFACE BOUNDARY CONDITIONS FOR WHITE DWARF EVOLUTIONARY CALCULATIONS. Fontaine, G.; Van Horn, H.M. (Department of Physics and Astronomy and C.E. Kenneth Mees Observatory). Astrophys. J. 197: No. 3, 647-650 (1 May 1975).

Analytic fits for the pressure, temperature, density, and fractional radius at the base of white dwarf envelopes are given for three chemical compositions: $X_H = 0.999$, $X_{He} = 0.999$ and $X_C = 0.999$. The fractional mass is chosen large enough so that the convection has stopped and ionization is complete at the base of an envelope. The fits are accurate to a few percent and are valid in the range $0.22 \leq M/M_\odot \leq 1.22$ and $10^{-4} \leq L/L \leq 10^{-1.5}$. (auth)

15142 FINITE, TWO-COMPONENT ISOTHERMAL SPHERES. I. EQUILIBRIUM MODELS. Taff, L.G.; Van Horn, H.M. (Department of Physics and Astronomy); Hansen, C.J.; Ross, R.R. Astrophys. J. 197: No. 3, 651-666 (1 May 1975).

The equilibria of finite (confined) isothermal gas spheres composed of particles with two different masses are studied. For given mass ratio μ and dimensionless radius ξ_0 there exists a one-parameter family of solutions. It is found that for $\mu < 3/2$ the total mass of the heavier

particles remains finite. Numerical calculations are carried out both for sequences with fixed central density ratio λ and for sequences with fixed total mass ratio but variable λ. In both cases the sequences display closed loops in the (U, V) phase plane. This suggests interesting, but quite disparate, stability properties for the two types of sequences. A comparison with the two-component dynamical calculations of Spitzer and Hart is also given, and confirms the equilibration of the cores of their models at later evolutionary times. (auth)

15143 THE TWO-TIME AUTOCORRELATION FUNCTION FOR FORCE IN BOUNDED GRAVITATIONAL SYSTEMS. Cohen, L. (Hunter College of The City University of New York); Ahmad, A. Astrophys. J. 197: No. 3, 667-673 (1 May 1975).

The correlation of the force at the same point but at two different times is calculated for bounded gravitational systems. Uniform density and a Gaussian distribution of velocity are assumed. The autocorrelation function decreases as $1/t^5$ for $t \to \infty$. This is in contrast to Chandrasekhar's result for infinite systems, where it decreases only as $1/t$. We also show that for an arbitrary distribution of speeds to decrease with time is generally $1/t^4$ in the case where the distribution is a function of the square of the velocity the decrease is $1/t^5$. The mean square velocity change is calculated via the autocorrelation function. (auth)

15144 ON TIDAL PHENOMENA IN A STRONG GRAVITATIONAL FIELD. Mashhoon, B. (Joseph Henry Laboratories, Princeton University). Astrophys. J. 197: No. 3, 705-716 (1 May 1975).

A simple framework based on the concept of quadrupole tidal potential is presented for the calculation of tidal deformation of an extended test body in a gravitational field. This method is used to study the behavior of an initially faraway nonrotating spherical body that moves close to a Schwarzschild or an extreme Kerr black hole. In general, an extended body moving in an external gravitational field emits gravitational radiation due to its center of mass motion, internal tidal deformation, and the coupling between the internal and center of mass motions. Estimates are given of the amount of tidal radiation emitted by the body in the gravitational fields considered. The results reported in this paper are expected to be of importance in the dynamical evolution of a dense stellar system with a massive black hole in its center. (auth)

15145 THE STABILITY OF NONUNIFORM ROTATION IN RELATIVISTIC STARS. Seguin, F.H. (California Institute of Technology). Astrophys. J. 197: No. 3, 745-765 (1 May 1975).

The stability of axisymmetric, differential rotation in nonmagnetic stars of uniform chemical composition is studied in the context of general relativity theory. Criteria are found for stability against local, linear, axisymmetric perturbations in conducting, viscous stars and in perfect fluid models. When stated in the proper language, the relativistic stability conditions have the same forms as the nonrelativistic conditions. When thermal conduction is much more efficient than viscosity, a star must be barotropic (the level surfaces of the pressure, P, and the total density of mass energy, ϵ, must coincide) and the gradient of the geometrical angular momentum ($L = -U_\phi/U_0$) must never point toward the interior of the quasi-cylindrical level surfaces of L. When viscosity dominates thermal conductivity by a large margin, a star must be barotropic and must have an entropy (per baryon, S) gradient which is parallel to the vector $(\partial\epsilon/\partial S)_P \nabla P$. When conduction and viscosity have comparable efficiencies or are absent, the criteria are slightly more complex. Applications of the stability conditions to models of specific astrophysical objects are discussed. (auth)

15146 ABSOLUTE EMISSION-LINE INTENSITIES FOR V1016 CYGNI. Ahern, F.J. (David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario). Astrophys. J. 197: No. 3, 639-645 (1 May 1975).

Photometric and spectrophotometric observations have been made of V1016 Cygni to determine the absolute intensities of the brighter emission lines. The Balmer decrement is much less steep than it was when measured in 1966 by O'Dell. Since the total brightness of the nebula has not increased since 1966, this cannot be interpreted as a decrease in reddening. We postulate an additional source of Hα emission which has since disappeared. The forbidden-line intensity ratios indicate a 1973 density of log $N_e = 6.86 \pm 0.04$, and temperature of $T_e = 11{,}900 \pm 500$ K. The change in the intensity ratio [O III] λ4363/[O III] λ5007 and [O III] λ4959/Hβ indicates that the density has not decreased by more than a factor of 1.6 between 1966 and 1973. A stratification model is presented for the case of a sphere of uniform density and temperature, and the relative intensities of He II λ4686/Hβ imply a blackbody effective temperature of $T_* = 164{,}000 \pm 3600$ K for the central star. If the Balmer line optical depth arises from hydrogen in the 2s state, we infer a radius of 1.0×10^{16} cm and a mass of $0.027 M_\odot$. Photometric observations relative to NGC 7027 indicate an Hβ flux of $3.69 \pm 0.20 \times 10^{-11}$ ergs cm^{-2} s^{-1}. (auth)

15147 THE IRC+10216 MOLECULAR ENVELOPE. Morris, M. (University of Chicago). Astrophys. J. 197: No. 3, 603-610 (1 May 1975).

Microwave emission lines from eight linear molecules have been reported in the direction of the carbon star, IRC+10216. We propose that the observed excitation of the rotational energy levels of these molecules is a result of absorption of infrared radiation into excited vibrational states and the subsequent decay back to the rotational levels of the ground vibrational state. A model of the source is constructed in which the molecules are contained in a spherically symmetric envelope (having an r^{-2} density dependence) around the central infrared source whose spectra and structure are known. The abundances of CS, SiS, SiO, and HC_3N are derived by fitting their observed lines to the prediction of the model. The molecular abundances yield an estimate for the total mass of the envelope of $(2-35) \times 10^{-3} M_\odot$. Conditions which determine the shapes of emission lines from expanding clouds are discussed, including the geometrical effect of excitation by the anisotropic infrared radiation field, the effect of finite optical depth, and the effect of partial resolution of the cloud. Comparison of the extended molecular cloud with the smaller CO shell observed by Geballe *et al.* suggests that IRC+10216 might have recently undergone more violent events than in previous eras. (auth)

15148 CA II H AND K REVERSALS IN CARBON STARS. Richer, H.B. (Department of Geophysics and Astronomy, University of British Columbia, Vancouver). Astrophys. J. 197: No. 3, 611-614 (1 May 1975).

Nine heavily exposed, high-dispersion blue spectrograms of seven different hot carbon stars were obtained. All spectra show a reversal in the Ca II H and K lines. The widths of the reversals were measured and, after establishing a calibration, the absolute visual magnitudes of the seven stars were derived. Four of the stars, all ordinary R stars, have absolute magnitudes and colors which place them close to the normal giant branch in the spectral range G8 to K2. The remaining three stars are all hydrogen-deficient carbon stars. All these stars are supergiants, lying along the Ib supergiant branch in a color-magnitude diagram. (auth)

15149 A CONSIDERATION OF THE NEUTRON CAPTURE TIME SCALE IN THE s-PROCESS. Blake, J.B. (Space Physics Laboratory, The Aerospace Corporation); Schramm, D.N. Astrophys. J. 197: No. 3, 615-620 (1 May 1975).

The question of the mean neutron capture interval in s-process nucleosynthesis is considered based upon s-process branching at ^{204}Tl and ^{151}Sm. It is concluded that the mean neutron flux during s-process nucleosynthesis was of the order of $10^{15}-10^{16} n$ s^{-1} cm^{-2} with a typical time scale between s-process neutron captures of the order of a few tens of years for nuclei with cross sections ~100 mb. The new experimental data (cross section and abundances) pertaining to Pb which were used in the present s-process neutron-flux analysis can have a significant effect on ^{205}Pb nucleochronology; the 2.3-keV excited state of ^{205}Pb also may be important. The ^{205}Pb chronology is discussed briefly in the Appendix. (auth)

15150 A REDISCUSSION OF THE ATMOSPHERIC EXTINCTION AND THE ABSOLUTE SPECTRAL-ENERGY DISTRIBUTION OF VEGA. Hayes, D.S. (Rensselaer Polytechnic Institute); Latham, D.W. Astrophys. J. 197: No. 3, 593-601 (1 May 1975).

For both the Lick and the Palomar calibrations of the spectral-energy distribution of Vega, the atmospheric extinction was treated incorrectly. We present a model for extinction in the Earth's atmosphere and use this model to calculate corrections to the Lick and Palomar calibrations. We also describe a method that can be used to fabricate mean extinction coefficients for any mountain observatory. We combine selected portions of the corrected Lick and corrected Palomar calibrations with the new Mount Hopkins calibration to generate an absolute spectral-energy distribution of Vega over the wavelength range 3300–10,800 Å. Until better measurements become available, we recommend the use of this calibration for all practical applications. (auth)

15151 MEASUREMENTS OF THE MONOCHROMATIC FLUX FROM VEGA IN THE NEAR-INFRARED. Hayes, D.S. (Rensselaer Polytechnic Institute); Latham, D.W.; Hayes, S.H. Astrophys. J. 197: No. 3, 587-592 (1 May 1975).

We have measured the monochromatic flux from Vega at several wavelengths in the near-infrared, primarily 10,400, 8090, and 6800 Å. Copper freezing-point blackbodies were used as standard sources, and were compared to Vega with a double-pass photoelectric spectrophotometer on the 12-inch (30 cm) and 60-inch (1.5 m) telescopes at Smithsonian's Mount Hopkins Observatory. We have identified a variety of sources of error and estimate that they might accumulate to as much as ±2 percent in our fluxes for Vega. Our monochromatic fluxes also provide a good calibration of the size of the Paschen discontinuity in hot stars. The color m (1/8090) − m (1/10,400) = −0.158 for Vega should be accurate to ±0.01 mag. For practical

applications, we have prepared an adopted absolute spectral-energy distribution (published separately) for Vega that combines our monochromatic fluxes with previously published spectral-energy distributions. In particular, this adopted calibration can be used to extrapolate our flux calibration back to 5556 Å, giving a value of 3.45×10^{-9} ergs s^{-1} cm^{-2} Å $^{-1}$ for the flux reaching the top of the Earth's atmosphere from Vega. This is about 3 percent larger than the value reported by Oke and Schild. (auth)

15152 LIMITS ON THE SOFT X—RAY AND EXTREME ULTRAVIOLET FLUX FROM RX ANDROMEDAE AND U GEMINORUM. Henry, P.; Cruddace, R.; Lampton, M.; Paresce, F. (Space Sciences Laboratory, University of California at Berkeley); Bowyer, S. Astrophys. J. Lett. 197: No. 3, L117-L121 (1 May 1975).

Soft X-ray and extreme-ultraviolet observations of RX And during a flare and U Gem during a quiescent state have been made. The 3 σ limits to the flux from RX And are 2.7×10^{-11} ergs cm^{-2} s^{-1} (44–125 Å) and 6.3×10^{-7} ergs cm^{-2} s^{-1} (145–515 Å); for U Gem the 3 σ limit is 7.5×10^{-11} ergs cm^{-2} s^{-1} (44–85 Å). A model of the soft X-ray emission from these systems is developed, and, when combined with these data, constrain the mass accretion rate onto the white dwarf to be less than $\sim 1\times10^{-8}$ $M_\odot$ yr^{-1}. For the U Gem system this implies that the accretion efficiency for the white dwarf is less than 10 per cent and that the observed increase in orbital period is due to mass loss from the system rather than mass transfer within the system. (auth)

15153 THE OCCULTATION OF BETA SCORPII BY JUPITER. VI. THE MASSES OF BETA SCORPII A_1 AND A_2. Elliot, J.L.; Rages, K.; Veverka, J. (Laboratory for Planetary Studies, Cornell University). Astrophys. J. Lett. 197: No. 3, L123-L126 (1 May 1975).

From images of the spectroscopic binary β Sco A, formed by the Jovian atmosphere during its 1971 May 13 occultation by Jupiter, the angular separation of the binary components was found to be $(1.496\pm0.018)\times10^{-3}$ arc sec. The combination of this measurement, the elements of the spectroscopic orbit, and the parallax determination of Bertiau yields masses of $21.1\pm3.2\,M_\odot$ for the primary (B0.5 V) and $12.7\pm1.9\,M_\odot$ for the secondary. New observations are suggested for improving the accuracy of the mass determinations. (auth)

15154 INVESTIGATION OF THE GALACTIC CLUSTER M34 (NGC 1039). Ryadchenko, V.P. (Kazan' State University). Sov. Astron.—AJ 18: No. 6, 744-745 (May 1975).

The luminosity functions are found for the cluster, the nucleus, and the corona. (auth)

15155 NEUTRON STARS IN SUPERNOVA REMNANTS. Amnuel', P.R.; Guseinov, O.Kh. (Shemakha Astrophysical Observatory, Academy of Sciences of the Azerbaidzhan SSR). Sov. Astron.—AJ 18: No. 6, 712-716 (May 1975).

Information on supernova remnants is analyzed in an effort to identify possible black holes. In order for synchrotron radiation to be maintained in a remnant its magnetic field should vary as $R^{-(1.2-1.5)}$. Continual injection of relativistic particles would also be required. The energy balance of supernova remnants, the intensification of the magnetic flux, and polarization data are discussed on the assumption that every remnant contains a neutron star (pulsar). Remnants containing black holes will not be observable at radio wavelengths. Searches for black holes in binary systems are more promising. (auth)

15156 THE SOLUTION PARAMETERS OF VERY CLOSE BINARY SYSTEMS. Mauder, H. (Tuebingen Univ. (F. R. Germany). Astronomisches Inst.). Astrophys. Space Sci.; 34: No. 2, 297-308(May 1975).

The problems encountered in the derivation of elements from the light curves of very close binary systems are discussed. It is shown that the rectification procedure is critically dependent on the underlying model. The assumption of a contact configuration leads to better coincidence of theoretical and observed light curves. The Fourier analysis method is used to derive the solution parameters of the examples YY Eri and AM Leo. (auth)

15157 THE LOCAL INHOMOGENEITIES OF THE CHEMICAL COMPOSITION ON THE SURFACE OF THE STRONTIUM Ap-STAR HD 140160. Khokhlova, V. L.; Rjabchikova, T. A. (AN SSSR, Moscow). Astrophys. Space Sci.; 34: No. 2, 403-411 (May 1975).

The surface inhomogeneities of the chemical composition of HD 140160 (χSer) were studied from the spectral line profiles. The method of quantitative analysis of local abundance proposed by Khokhlova (1974) was used. The overabundance of Sr up to 10^3 was found in three "spots" on the surface of the star and normal abundance outside the spots. Iron was found to be over-abundant up to 10 times in four spots and deficient by 10 times outside the spots. Some arguments in favor of a supernova hypothesis are mentioned to explain the deficiency of iron. (auth)

15158 W URSAE MAJORIS STARS: PERIOD-SPECTRAL TYPE RELATION AND PERIOD CHANGES. Yamasaki, A. (Tokyo Univ. (Japan). Coll. of General Education). Astrophys. Space Sci.; 34: No. 2, 413-424(May 1975).

The relation between period and spectral type is examined for 33 W Ursae Majoris stars for which accurate observations have enabled the classification of their eclipse types at the primary minimum (transit (A) or occultation (W)). About a half of the examined stars are of A-type, and the rest correspond to W-type. Periods of W-type systems are found to fall within 0.25–0.5 days, while periods of A-type systems range between 0.25–0.9 days. For A-type systems certain period-spectral type relations seem to hold, but for W-type systems no definite relation could be found. Statistically, a W Ursae Majoris star will undergo a period change every $\sim$17000 cycles, on the average, and a time scale for the period change $(d \ln P/dt)^{-1}$ is estimated to be about 10^6 years. (auth)

15159 A NOTE ON CRITICALLY ROTATING POLYTROPES. Williams, P. S. (City of London Polytechnic (UK)). Astrophys. Space Sci.; 34: No. 2, 425-430(May 1975).

The structure of critically rotating polytropes is calculated using two (related) Roche-type approximation schemes, one of which has been developed for stellar models. Comparisons with other results are made as a validation of these methods in stellar structure calculations. (auth)

15160 FOURIER ANALYSIS OF THE LIGHT CURVES OF ECLIPSING VARIABLES. I. Kopal, Z. (Manchester Univ. (UK)). Astrophys. Space Sci.; 34: No. 2, 431-457(May 1975).

The aim is to pioneer a new approach to the analysis of the light changes of eclipsing binary systems in the frequency domain, and to point out its merits in comparison with a conventional treatment of the same problem in the time-domain which has been developed so far. Explicit results pertaining to mutual eclipses of spherical stars exhibiting uniformly bright discs are given. An extension of these results to the case of arbitrary limb-darkening, and taking account of mutual distortion of both components, will be given in subsequent communications. (auth)

15161 ON THE NATURE OF γ-RAY BURSTS. Prilutski, O. F.; Usov, V. V. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij). Astrophys. Space Sci.; 34: No. 2, 395-401 (May 1975).

The hypothesis on the γ-ray burst generation in the process of the collapse of supermassive bodies in the nuclei of active galaxies is considered. It is shown that γ-ray burst properties observed may be interpreted within the frames of the given model. A statistical test for choosing hypotheses on γ-ray burst nature is discussed. (auth)

15162 THE DISTRIBUTION OF INTERSTELLAR MATTER IN IC 5146. Samson, W. B. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 34: No. 2, 377-386(May 1975).

The very young star cluster IC 5146 is studied using star counts, with a view to determining the distribution of interstellar matter in a region where star formation recently occurred. IC 5146 is embedded in a dark nebula which is very dense near its centre. The total mass of interstellar dust in the nebula is found to be about 4.5 $M_\odot$. Comparison of radio and optical observations of the region indicates that gas and dust are not separated to any great degree by radiation from the embedded stars. A gas/dust ratio of about 150/1 by mass is found. This ratio varies with the dust grain model used. (auth)

15163 THE DISTRIBUTION OF INTERSTELLAR MATTER IN NGC 654. Samson, W. B. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 34: No. 2, 363-376(May 1975).

The young cluster NGC 654 is studied using UBV photographic photometry with a view to determining the distribution of interstellar matter in a region where star formation recently occurred. NGC 654 is found to be enclosed in a shell of interstellar matter of mass 1500 M. The mass of all stars in the cluster is 4000 $M_\odot$. (auth)

15164 ON THE INTRINSIC PROPERTIES OF CEPHEIDS IN THE GALAXY, IN ANDROMEDA, AND IN THE MAGELLANIC CLOUDS. Iben, I. Jr.; Tuggle, R.S. (University of Illinois, Champaign—Urbana). Astrophys. J. 197: No. 1, 39-54 (1 Apr 1975).

With opacities and opacity derivatives fitted by spline interpolation to fine-grid Cox-Stewart opacity tables, pulsation calculations have been performed in the linear nonadiabatic approximation to provide pulsation parameters for Cepheid models covering a range of masses, luminosities, and compositions required for a discussion of Population I variables. Analytic approximations to the results are used to illustrate how the location of one boundary of the instability strip in either the *LT*, plane or the *PL* plane varies with the slope and normalization assumed for the mean mass-luminosity (*ML*) relationship for Cepheids. The results of pulsation calculations are used in conjunction with observational data to estimate (*a*) absolute magnitudes, (*b*) color-temperature conversions,

(*c*) masses, and (*d*) composition parameters characterizing Cepheids in three extragalactic complexes: SMC, LMC, and M31. The slope of the *ML* relationship, the heavy-element abundance, the helium abundance, and the distance modulus for Cepheids in each of the three complexes are estimated, respectively to be: $d \log L/d \log M \simeq 3.3$, 3.65, and 4.0; $Z \simeq 0.005$, 0.01, 0.02; $Y \simeq 0.29 \pm 0.06$; and distance modulus $\simeq$19.25, 18.73, and 24.40. (auth)

15165 UBV PHOTOMETRY OF THE CEPHEID V367 SCUTI IN THE OPEN CLUSTER NGC 6649. Madore, B.F. (Institute for Astronomy, Cambridge University); Van Den Bergh, S. Astrophys. J. 197: No. 1, 55-65 (1 Apr 1975).

UBV photometry has been obtained for the Cepheid V367 Sct and for the cluster NGC 6649 in which it is located. The cluster is found to have $(m\text{-}M)_V = 15.4 \pm 0.2$ and suffers a reddening $E_{B-V}(B0) = 1.37$. For the Cepheid V367 Sct, $\langle V \rangle = 11.58$ and $\langle B \rangle - \langle V \rangle = 1.76$, so that $M_{(V)} = -3.8 \pm 0.2$ and $\langle B \rangle_0 - \langle V \rangle_0 = 0.49$. A period of 5.255 ± 0.002 days is derived for V367 Sct. NGC 6649 also contains a nonvariable star in the Cepheid instability strip. Futhermore, the cluster appears to contain two red giants, one of which is a variable. (auth)

15166 UBV PHOTOMETRY OF NGC 2439. White, S.D.M. (David Dunlap Observatory, University of Toronto). Astrophys. J. 197: No. 1, 67-75 (1 Apr 1975).

Photoelectric and photographic measures of 183 stars in the field of NGC 2439 show the cluster to be $\sim 2 \times 10^7$ years old and 4.45 kpc from the Sun. Three supergiant stars, including the G0 Ia star R Puppis, are found to be very probable members on the basis of photometric, spectral, and radial-velocity data. An extended group of high-luminosity B stars may also be associated with the cluster. (auth)

15167 FURTHER STUDY OF THE STELLAR CLUSTER EMBEDDED IN THE OPHIUCHUS DARK CLOUD COMPLEX. Vrba, F.J. (Steward Observatory, University of Arizona); Strom, K.M.; Strom, S.E.; Grasdalen, G.L. Astrophys. J. 197: No. 1, 77-84 (1 Apr 1975).

An extension of a 2-μ map of the Ophiuchus dark cloud carried out by Grasdalen, Strom, and Strom has brought to 67 the total number of detected 2-μ point sources. Additional infrared photometry has considerably strengthened our previous conclusion that these sources represent the brighter members of a young cluster obscured by dark-cloud material. The luminosity function derived for the Ophiuchus cluster is virtually identical with that observed for other young clusters. The reddening law in this dense, dark-cloud region, derived from our photometry, is significantly different from the interstellar mean; *R*, the ratio of total to selective extinction, is larger, suggesting a particle-size distribution peaked toward larger sizes. Furthermore, the ice absorption feature at 3.05 μ has been observed for two sources in this region. The observed strength of this feature seems consistent with the range found for other dense, dark clouds. (auth)

15168 INTERSTELLAR ABSORPTION LINES IN THE SPECTRUM OF ZETA OPHIUCHI. Morton, D.C. (Princeton University Observatory). Astrophys. J. 197: No. 1, 85-115 (1 Apr 1975).

Extensive high-resolution scans with the ultraviolet spectrometer on the *Copernicus* satellite have been combined with the available ground-based data on interstellar lines to obtain temperatures, densities and abundances in H I clouds H II regions in the direction of ζ Oph. Column densities have been obtained for 21 elements in various stages of ionization. A new determination for CO and the results of H_2, HD, CH, CH^+, and CN for other authors also have been included. In addition, upper limits have been reported for five elements and 11 molecules. In the ultraviolet scans, 45 lines remain unidentified. Radial velocities and curves of growth were used to locate the species seen in the ultraviolet into one or more of the six clouds already known from the visible spectra. The H_2, HD, and most of the neutral atoms are concentrated in one cloud at a heliocentric velocity of -14.4 km s^{-1}, while N I, O I, Ar I, and most of the first ions are distributed over at least two of these clouds. The velocities of the higher ion states implied there are H II regions in addition to the Strömgren sphere. Calculations of the ionization equilibrium for C, Mg, S, and Ca have shown that the electron density $n_e \sim 0.7$ cm^{-3} in the -14.4 km s^{-1} cloud. Since the ionization of carbon is the primary source of the electrons, the ratio C II /H requires that $n_H \sim 10^4$ cm^{-3} for the total hydrogen nuclei, with a fractional ionization $n_e/n_H \sim 7 \times 10^{-5}$. Both densities could be up to 20 times larger if the cloud is close to the star. The cloud must be no more than 0.05 pc thick. The populations of the fine-structure levels in the C I ground state require $T = 19$°K. The HD and the excited rotational levels of H_2 need temperatures between 56° and 115°, though the lines appear to have the same velocity as the C I, probably indicating that the dense cloud must have some associated hotter regions. Relative to hydrogen, most of the elements in the H I clouds are depleted by factors of 3 to 4000 compared with the solar system abundances. Only sulfur and zinc are presented in the gas with near normal abundances. Several elements, particularly Al, Si, and Fe, appear to be depleted in the H II regions as well, but nitrogen is normal. (auth)

15169 OPTICAL INTERSTELLAR LINES IN SOUTHERN SUPERGIANTS. Cohen, J.G. (Kitt Peak National Observatory, Cerro Tololo Inter-American Observatory). Astrophys. J. 197: No. 1, 117-122 (1 Apr 1975).

Photoelectric photometry of 35 southern supergiants reveals a good correlation of the central residual intensity of the diffuse interstellar line at 4430 Å with color excess. From spectra of the brighter southern supergiants, I have derived column densities of Na I and Ca II, and, in a few cases, of CH and CH^+. These results are averaged and compared with previous studies of the interstellar medium at high galactic latitudes and in the denser regions of the plane. The basic peculiarities of the interstellar lines in these two regions, as discussed in Papers I and II, are more sharply delineated by this comparison. Models for the gas in the halo are derived, and I obtained the mass of gas in the halo (from 1×10^7 to 6×10^7 $M_\odot$) and a maximum value of the metal depletion of the halo gas relative to the disk gas (from 300 to 90, depending on whether grains exist in the halo). This maximum value implies that the gas in the halo has been significantly contaminated by material which has undergone nuclear processing. (auth)

15170 SOME INTERESTING BRIGHT SOUTHERN STARS OF EARLY TYPE. Slettebak, A. (Perkins Observatory, Ohio State and Ohio Wesleyan Universities). Astrophys. J. 197: No. 1, 137-138 (1 Apr 1975).

The spectra of 10 bright southern stars of early type, considered to be interesting for a variety of reasons and worthy of further study, are described. (auth)

15171 He I λ4922 PROFILES IN B STARS: CALCULATIONS WITH AN IMPROVED LINE BROADENING THEORY. Mihalas, D. (High Altitude Observatory, National Center for Atmospheric Research); Barnard, A.J.; Cooper, J.; Smith, E.W. Astrophys. J. 197: No. 1, 139-142 (1 Apr 1975).

Theoretical profiles for the He I λ4922 line in B star spectra have been computed using the improved broadening theory of Barnard, Cooper, and Smith, and the level populations calculated by Auer and Mihalas from a simultaneous self-consistent solution of the coupled transfer and statistical equilibrium equations. The revised broadening theory yields excellent agreement with laboratory measurements of the width and intensity of the forbidden ($2p\ ^1P^0$-$4f\ ^1F^0$) transition. The results of this paper show that stellar profiles computed with the new theory are in excellent agreement with observed profiles, and the discrepancies between observation and theory that existed previously have now been removed. (auth)

15172 RESONANCE LINE TRANSFER WITH PARTIAL REDISTRIBUTION. III. Mg II RESONANCE LINES IN SOLAR-TYPE STARS. Milkey, R.W. (Kitt Peak National Observatory); Ayres, T.R.; Shine, R.A. Astrophys. J. 197: No. 1, 143-145 (1 Apr 1975).

We discuss the gravity dependence of the Mg II resonance lines calculated including effects of partial redistribution in frequency. Using chromospheric models scaled from a solar model, we demonstrate the increased decoupling of the radiation temperature of the k_1 feature from the minimum electron temperature in lower-gravity models. The limb darkening of the *k*-line in the main-sequence model is also discussed. (auth)

15173 THE OBSERVABILITY OF IONIZED INTERSTELLAR GAS IN GLOBULAR CLUSTERS. Scott, E.H.; Rose, W.K. (Astronomy Program and Center for Theoretical Physics, University of Maryland, College Park). Astrophys. J. 197: No. 1, 147-153 (1 Apr 1975).

Recent radio observations have set upper limits to the amounts of neutral and ionized gas in globular clusters. In an attempt to understand these observations, we calculate "stellar wind" type solutions for the outflow of ionized gas from globular clusters. Our models, which are based on the mass distributions of Peterson and King, predict only about 1 $M_\odot$ or less of ionized gas within a few parsecs of the cluster centers in most cases and thus lead to less free-free emission than the observed upper limits of Hills and Klein. However, our results are sensitive to the total stellar mass, its spatial distribution, and the metal abundance of the gas. We find that the mass of ionized gas for one cluster, NGC 6388, may be sufficient for observability. (auth)

15174 THE MASS AND TIDAL RADIUS OF OMEGA CENTAURI. Poveda, A.; Allen, C. (Instituto de Astronomía, Universidad Nacional Autónoma de México). Astrophys. J. 197: No. 1, 155-157 (1 Apr 1975).

Using Harding's velocity measurements and rotation curve, we obtain two new values for the mass of ω Centauri: (*a*) $M \geq 3.23 \times 10^6$ $M_\odot$, from the rotation curve; (*b*) $M \geq 3.24 \times 10^6$ $M_\odot$, from the virial theorem. The discrepancy by a factor of 5 between our values and those of Dickens and Woolley is discussed. With the new mass, the inconsistency found by Keenan, Innanen, and House between the observed and the calculated values for the tidal radius vanishes. The resulting mass-luminosity ratio $(M/L)_B \geq 3.2$ is significantly larger than the M/L ratio for other globular clusters. (auth)

15175 INTERPRETATION OF THE STELLAR METALLICITY DISTRIBUTION. Tinsley, B.M. (The University of Texas at Dallas and at Austin). Astrophys. J. 197: No. 1, 159-162 (1 Apr 1975).

The dispersion in metal abundances of stars of a given age is similar to that in the abundance distribution of dwarfs with lifetimes greater than the age of the Galaxy. Thus the latter distribution cannot be correctly interpreted unless the former dispersion is taken into account. With this consideration, dynamical models for the formation of the Galaxy by collapse, and models for chemical evolution that consider accretion of gas shed by halo stars, no longer predict too few moderately metal-poor G-K dwarfs in the solar neighborhood. (auth)

15176 IONIZATION EQUILIBRIA IN THE ATMOSPHERES OF LATE-TYPE GIANTS. Auman, J.R. (Institute of Astronomy and Space Science, University of British Columbia); Woodrow, J.E.J. Astrophys. J. 197: No. 1, 163-173 (1 Apr 1975).

Model atmospheres were constructed for late-type giants in which the LTE assumption was relaxed in the calculation of the ionization equilibria of the metals that contribute significantly to the density of free electrons. According to our findings, ionization equilibria are shifted considerably in the atmospheres with effective temperatures less than 3000 *K*. The electron pressure is increased by a factor of 60 in the model with T_e=2000 *K*, and by a factor of 14 in the model with T_e=2500 *K*. The approximations and sources of error in our models are discussed, as well as the possible deviations from LTE in the dissociation equilibria of the molecules. (auth)

15177 STRATIFICATION EFFECTS IN THE PLANETARY NEBULA NGC 7009. Aller, L.H.; Epps, H.W. (Astronomy Department, University of California at Los Angeles). Astrophys. J. 197: No. 1, 175-184 (1 Apr 1975).

Spectrophotometric scans (λλ4000–8600 Å) have been obtained with the Wampler–Robinson image-tube scanner at the Cassegrain focus of the Lick 3-*m* telescope. We observed both east and west ansae, as well as two points in the bright ring north of the central star. Scans of the region λλ5400 to 7330 were also secured in the bright ring near the west end of the major axis. Profound excitation differences noted by Berman, by Aller, and by Ford and Rubin are substantiated, and an attempt is made to derive ionic concentrations, electron temperatures, and densities. Particular attention is called to the large variations in the Hα/[N II] ratio, which ranges from around 2.0 in the ansae to about 0.03 in the bright ring, i.e., a range of nearly two orders of magnitude. The data illustrate the difficulties in attempting to derive elemental abudances from nebular-line intensities with either radiative models or empirical corrections. (auth)

15178 A VARIATIONAL CALCULATION OF THE FUNDAMENTAL FREQUENCIES OF QUADRUPOLE PULSATION OF FLUID SPHERES IN GENERAL RELATIVITY. Detweiler, S.L. (University of Chicago). Astrophys. J. 197: No. 1, 203-217 (1 Apr 1975).

A variational principle is used to calculate, in a relatively simple manner, the frequencies of quadrupole oscillation of relativistic neutron star models for a variety of equations of state and central densities. Typical periods and damping times are on the order of milliseconds and seconds, respectively, in agreement with earlier estimates obtained by Thorne in a different manner. For spheres of incompressible fluids, the analyses indicate that the fundamental quadrupole mode becomes unstable as 2M/R attains its limiting value of 8/9. (auth)

15179 FE I FLUORESCENCE IN T TAURI STARS II. CLUES TO THE VELOCITY FIELD IN THE CIRCUMSTELLAR ENVELOPE. Willson, L.A. (Erwin W. Fick Observatory, Department of Physics, Iowa State University). Astrophys. J. 197: No. 2, 365-370 (15 Apr 1975).

Radial velocity measurements for the fluorescent iron lines λλ4063, 4132 for RW Aur compared with the primary emission lines of hydrogen and calcium show that Fe I λ3969.26 has been shifted onto Hε, as was predicted. Profiles of Ca II H–Hε and Ca II K clearly demonstrate the effects of absorption by Fe I λ3969.26. The relative line strengths indicate that Hε provides about 50 percent of the excitation for the fluorescent lines, and Ca II H the rest. Profiles of the fluorescent iron lines indicate that (1) the lines are formed at 3–10 stellar radii from the star, and (2) rotational velocities are equal to or exceed expansion velocities at this distance. The Ca II K profile gives evidence that within 1.5 stellar radii, rotational velocities also dominate. The conclusion is drawn that mass-loss rates calculated on the basis of a purely expanding envelope may be in error by factors of 2 to 10 for T Tauri stars. Implications of these results for the envelope structure are also discussed. (auth)

15180 ULTRAVIOLET SPECTROPHOTOMETRY FROM *Gemini* 11 OF STARS IN ORION. Morgan, T.H.; Spear, G.G.; Kondo, Y.; Henize, K.G. (NASA Lyndon B. Johnson Space Center, Houston). Astrophys. J. 197: No. 2, 371-377 (15 Apr 1975).

Ultraviolet spectrophotometry in the wavelength region 2600–3600 Å is reported for the bright early-type stars β, η, γ, δ, ι, ε, σ, ξ, and κ Ori. The results are in good agreement with other observations, and with the possible exception of the supergiants, are in good agreement with recent line-blanketed model atmospheres. There is evidence that the supergiants possess a small ultraviolet deficiency shortward of 3000 Å relative to main-sequence stars of similar spectral type. The most extreme example of this phenomenon is the star κ Ori. (auth)

15181 ULTRAVIOLET PHOTOMETRY FROM THE ORBITING ASTRONOMICAL OBSERVATORY. XIX. ATMOSPHERIC PROPERTIES OF THE DETACHED BINARIES VV ORIONIS AND MR CYGNI. Eaton, J.A. (Washburn Observatory, University of Wisconsin, Madison). Astrophys. J. 197: No. 2, 379-391 (15 Apr 1975).

A series of OAO 2 light curves for VV Ori covering the wavelength range 1300–4300 Å is presented. Analysis of these light curves using light-curve synthesis techniques leads to a mass ratio for the system consistent with radial-velocity observations and to limb darkening consistent with theory. The gravity darkening for the primary, however, is *much less* (g=0.3) than theoretically expected for stars with radiative envelopes. Analysis of light curves for MR Cyg, a system similar to VV Ori, indicates that the gravity darkening of MR Cyg *could be* as low as that found for VV Ori. The mass-luminosity relation applied to this system, however, implies that the primary is probably fully gravity darkened or that the stars may not be adequately represented by Roche potentials. For both of these systems the wavelength dependence of the reflection effect is qualitatively that which is expected from the predictions of Rucinski, although for VV Ori it is higher than expected in the ultraviolet. (auth)

15182 BROAD ABSORPTION FEATURES IN A CENTAURI. Underhill, A.B.; Fahey, R.P.; Klinglesmith, D.A. (Goddard Space Flight Center). Astrophys. J. 197: No. 2, 393-398 (15 Apr 1975).

Nightly mean intensity tracings of the spectrum of a Centauri in the neighborhood of lines from multiplets 41 and 43 of Fe I are presented for 10 consecutive nights. On some nights broad, shallow absorption features appear at the positions of the Fe I lines. (auth)

15183 INSTABILITY AGAINST NONRADIAL OSCILLATIONS OF MODELS FOR BETA CEPHEI STARS. Aizenman, M.L.; Cox, J.P. (Joint Institute for Laboratory Astrophysics, National Bureau of Standards); Lesh, J.R. Astrophys. J. 197: No. 2, 399-404 (15 Apr 1975).

We have found nuclear-driven vibrational instability in some of the lower g^+ modes in a 10 $M_\odot$ model evolved off the ordinary hydrogen-burning main sequence, during the initial stages of shell hydrogen burning. It is conceivable that this instability may be the basic excitation mechanism for the β Cephei stars. Nonlinear model coupling is suggested as the mechanism for the β Cephei stars. Nonlinear model coupling is suggested as the mechanism for the β Cephei stars. Nonlinear model coupling is suggested as the mechanism by which the effects of this g^+ mode instability are transferred to the shorter-period f or p, or perhaps radial harmonic, modes which are probably observed. (auth)

15184 THEORETICAL STUDIES OF MASSIVE STARS. I. EVOLUTION OF A 15 $M_\odot$ STAR FROM THE ZERO-AGE MAIN SEQUENCE TO NEON IGNITION. Endal, A.S. (Department of Physics and Astronomy, University of Florida, Gainesville). Astrophys. J. 197: No. 2, 405-413 (15 Apr 1975).

The evolution of a 15 $M_\odot$ star from the zero-age main sequence to neon ignition has been computed by the Henyey method. The hydrogen-rich envelope and all shell sources were explicitly included in the models. An algorithm has been developed for approximating the results of carbon burning, including the branching ratio for the $^{12}C+^{12}C$ reaction and taking some secondary reactions into account. Penetration of the convective envelope into the core is found to be unimportant during the stages covered by the models. Energy transfer from the carbon-burning shell to the core by degenerate electron conduction becomes important after the core carbon-burning stage. Neon ignition will occur in a semidegenerate core and will lead to a mild "flash." Detailed numerical results are given in an appendix. Continuation of the calculations into later stages and variations with the total mass of the star will be discussed in later papers. (auth)

15185 THE ENVELOPES OF TYPE II SUPERNOVAE. Kirshner, R.P. (Hale Observatories, California Institute of Technology); Kwan, J. Astrophys. J. 197: No. 2, 415-424 (15 Apr 1975).

Absolute spectral energy distributions of Type II supernovae have been used to derive a consistent physical picture of their ejected envelopes. Continuum observations are consistent with a photosphere that expands to a radius of 10^{15} cm and then begins to shrink at nearly constant temperature. The hydrogen recombination implies an electron density which decreases from 10^{10} to 2×10^7 cm^{-3} in a time of 400 days. A total hydrogen mass in excess of 1 $M_\odot$ is required to prevent rapid recombination in the envelope. The Ca II lines at λλ8600 and 7300 are produced collisionally: an explicit calculation of the emissivity demonstrates that the line ratios and strengths are consistent with solar abundances, a total mass of a few solar masses, and the electron density derived from hydrogen recombination. Similarly, the [O I] λ6300 emission is consistent with this general picture. A quantitative analysis of line optical depths confirms the identifications of Na I λ5890, Mg I

λ5174, and the Fe II blends near λλ4600 and 5100. A possible identification of K I λ7677 is suggested, while other candidates are rejected. (auth)

15186 A SEARCH FOR IONIZED HYDROGEN IN GLOBULAR CLUSTERS. Erkes, J.W.; Davis Philip, A.G. (State University of New York at Albany). Astrophys. J. 197: No. 2, 533-534 (15 Apr 1975).

No evidence for radio emission at 3 and 6 cm from ionized hydrogen was found in the globular clusters investigated. (auth)

15187 VECTOR POTENTIAL AND METRIC PERTURBATIONS OF A ROTATING BLACK HOLE. Chrzanowski, P.L. (Center for Relativity Theory, Department of Physics, The University of Texas at Austin, Austin, Texas 78712 and Department of Physics and Astronomy, The University of Maryland, College Park, Maryland 20742). Phys. Rev. D 11: No. 8, 2042-2062 (15 Apr 1975).

The assumption of factorized Green's functions together with the inhomogeneous Teukolsky equations are used to derive analytic expressions for homogeneous metric (and vector potential) perturbations of a Kerr black hole. These homogeneous solutions are used to construct solutions to the perturbation equations when sources are present. What one finds are particularly simple formulas for the energy and angular momentum flux in the asymptotic regions $r^* \to \pm\infty$. (auth)

15188 MOLECULAR COLUMN DENSITIES IN SELECTED MODEL ATMOSPHERES. Johnson, H.R. (Indiana University); Beebe, R.F.; Sneden, C. Astrophys. J. Suppl. Ser. 29: No. 280, 123-136 (Apr 1975).

Molecular column densities are presented for 35 molecules in a variety of cool stellar model atmospheres. From an examination of the predicted column densities, we draw the following conclusions: (1) OH might be visible in carbon stars which have been generated from triple-α burning, but will be absent from carbon stars generated from the CNO bi-cycle. (2) The TiO/ZrO ratio shows small but interesting variations as C/O is changed and as the effective temperature is changed. (3) The column density of silicon dicarbide (SiC_2) is sensitive to abundance, temperature, and gravity; hence, all relationships between the strength of SiC_2 and other stellar parameters will show appreciable scatter. There is, however, a substantial luminosity effect present in the SiC_2 column densities. (4) Unexpectedly, SiC_2 is anticorrelated with C_2. (5) The presence of SiC_2 in a carbon star allows us to eliminate the possibility that these stars are both "hot" ($T_{eff} \geq 3000$ K) and have been produced through the CNO bi-cycle (so that C/H < solar). (auth)

15189 NEUTRINO OPACITY OF NEUTRON-STAR MATTER. Sawyer, R.F. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 11: No. 10, 2740-2745 (15 May 1975).

Scattering of neutrinos from neutron-star matter is calculated for the case of very high neutron-star temperatures, under the assumption of a neutral-current interaction of the form given by the Weinberg-Salam theory. The resulting neutrino opacity depends in an interesting way upon the equation of state of the matter. The maximum possible opacity of a thin layer of matter is estimated for the case of an arbitrary equation of state. (auth)

15190 CURVE-OF-GROWTH ANALYSIS OF A RED GIANT IN M67. Griffin, R. (Cambridge Univ., Eng.). Mon. Not. R. Astron. Soc.; 171: No. 1, 181-193(Apr 1975).

A coudé spectrogram of a red giant (IV-202) in M67 is analysed, with respect to Arcturus, by the differential curve-of-growth technique. The overall metal abundance is found to be approximately twice that in Arcturus, i.e., half the solar value. There is an indication that the star has subsolar mass. Although these results are quantitatively very sensitive to the temperature assigned to the star, error limits exclude the interpretation that IV-202 is "super-metal-rich". (auth)

15191 ACCRETION AND EFFLUXION OF MASS AND ANGULAR MOMENTUM. Henriksen, R. N.; Heaton, K. C. (Queen's Univ., Kingston, Ont.). Mon. Not. R. Astron. Soc.; 171: No. 1, 27-34(Apr 1975).

The hydrodynamical accretion and effluxion of isentropic or isothermal material with uniform specific angular momentum, L sin θ, is solved exactly on a stream line, θ = constant. The critical value for L, $L_m(\gamma)$, above which accretion is severely curtailed and effluxion is rotationally driven, is found as the principal new result. This critical value appears as the maximum L for which Venturi flow (i.e., with a choke point) occurs. The accretion-effluxion rate, A, and the location of the choke point, R, are given exactly for the Venturi curves as a function of L. The topology of the solutions is shown to include a vortex (elliptic) point as well as a choke (hyperbolic) point, and the figures display this behavior explicitly. (auth)

15192 CENTRAL GRAVITATIONAL REDSHIFTS FROM STATIC MASSIVE OBJECTS. Das, P. K.; Narlikar, J. V. (Tata Inst. of Fundamental Research, Bombay). Mon. Not. R. Astron. Soc.; 171: No. 1, 87-102(Apr 1975).

The possibility of obtaining high gravitational redshifts from static massive objects is investigated in an attempt towards finding a satisfactory explanation of the redshifts of the QSOs. Following Bondi's approach equilibrium configurations of the core and envelope type are discussed within the framework of general relativity. Gravitational redshifts from the centre of the core, from the core-envelope boundary and from the surface of the object are calculated in a variety of cases and their dependence on the equation of state is studied. In a possible application of these models to QSOs the emission is considered to arise from an optically thin central region surrounded by an exterior which lets through a fraction of the emitted light. The mass of such an object can be estimated from the emission line data, as discussed with the example of 3 C 9. (auth)

15193 SYMBIOTIC STARS AND DUST. Webster, B. L.; Allen, D. A. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Not. R. Astron. Soc.; 171: No. 1, 171-180(Apr 1975).

New members of the class of very high excitation symbiotic stars, with relatively strong lines of [Fe VII], have been found. The strong unidentified emission band at 6830 Å has been detected in two of these and its identification is discussed. There is a subgroup of high excitation objects which also emit near-infrared thermal radiation from dust grains and are distinguished by the properties of their emission-line spectra. It is proposed that the dust exists in neutral gas and that the optical and infrared spectra of this subgroup of symbiotic stars arise because they are radiation bounded either at their perimeter or around condensations. (auth)

15194 INFORMATION ENTROPY (THE COMPLICATION) OF THE CHEMICAL COMPOSITION OF SOME COSMIC AND EARTH SYSTEMS. Petrov, T. G. Vestn. Leningrad. Univ., Geol., Geogr.; No. 4, 39-43(Dec 1974). (In Russian).

The information entropy i.e., the complication of the chemical composition is found to increase in the series interstellar gas—star formations—planets as well as in the sequence atmosphere—hydrosphere—biosphere—lithosphere. There is a dependence between the complication of the chemical composition of these systems and their component mobility. According to the average composition data the calculated effusive rocks complication is higher than the intrusive one. Some reasons of the mentioned tendencies are considered. (auth)

15195 NEW SPECTROSCOPIC ORBIT OF THE ECLIPSING BINARY 68U HER. Kovachev, B. J. (Astronomical Section, BAS, Sofia); Seggewiss, W. Astron. Astrophys., Suppl. Ser.; 19: No. 3, 395-402(Mar 1975).

New orbital elements of 68u Her have been determined from Crimea spectrograms obtained in 1962. The new values of the velocity amplitudes and the γ velocity differ only slightly from earlier results. The discrepancy between photometric and spectroscopic orbit is discussed. (auth)

15196 Fe I AND CH EQUIVALENT WIDTH MEASUREMENTS FOR SIXTY-ONE F, G, AND K TYPE STARS. Hernshaw, J. B. (Observatoire de Paris, Meudon, France). Astron. Astrophys., Suppl. Ser.; 19: No. 3, 321-336(Mar 1975).

Equivalent width measurements are presented for selected Fe I lines and CH blends in the blue-green region of sixty-one F, G, and K stars, observed at high dispersion at the Observatoire de Haute-Provence and at Mt. Stromlo Observatory. (auth)

15197 PHOTOMETRIC STUDY OF U CEP. Part II. Tables. Hall, D. S.; Walter, K. (Univ., Tuebingen, Ger.). Astron. Astrophys., Suppl. Ser.; 19: No. 3, 337-350(Mar 1975).

Part II contains the tables giving explicit numerical representations of photometric solutions, new UBV observations of the variable, and the compilation of data between 1880 and 1970 concerning the slope of intensity during the phases of total eclipse. (auth)

15198 MODEL-ATMOSPHERE ANALYSIS OF THE SPECTRUM OF ARCTURUS (BASIC SPECTROSCOPIC DATA). Maeckle, R. (Univ., Kiel); Griffin, R.; Griffin, R.; Holweger, H. Astron. Astrophys., Astrophys., Suppl. Ser.; 19: No. 3, 303-319(Mar 1975).

Five tables are given which supplement the earlier analysis of the Arcturus spectrum by the authors. The tables contain basic observational data and computational results for individual spectral lines. (auth)

15199 SPACE DISTRIBUTION OF M GIANTS IN THE WARNER AND SWASEY LUMINOSITY FUNCTION FIELD LF 14. Vleeming, G. (Univ., Amsterdam). Astron. Astrophys., Suppl. Ser.; 19: No. 1, 21-44(Jan 1975).

A survey of M-type stars has been made in the square field of 3° × 3° in LF14. Using Schalen's method, space densities have

been calculated for the M2-M4, M5-M6.5, and M7-M9 groups. The results were then corrected for interstellar absorption by means of Seeliger's method. The infrared interstellar absorption as a function of distance was determined using data of M2, M3, and M4 stars and those published by Neckel. A short discussion of the results is given. (auth)

15200 SIX UBV PHOTOELECTRIC SEQUENCES IN VELA ($l = 257°$ to $281°$). Denoyelle, J. (Royal Observatory, Uccle, Belgium). Astron. Astrophys., Suppl. Ser.; 19: No. 1, 45-55 (Jan 1975).

For six sequences along the southern galactic equator, UBV values and an identification chart are presented. Special attention was given to the fields around the galactic longitude 275°, where a possible link between the Carina and the Vela spiral features might be detected. The sequences will be used for photographic photometry on ESO-Schmidt plates, which cover the whole Vela region from 257° to 284°. (auth)

15201 SPECTROGRAPHIC OBSERVATIONS OF β LYR DURING THE INTERNATIONAL CAMPAIGN OF 1971. Flora, U.; Hack, M. Astronomical Observatory, Trieste, Italy). Astron. Astrophys., Suppl. Ser.; 19: No. 1, 57-89(Jan 1975).

The results of the spectrographic observations of β Lyr during the international campaign of July–August 1971 are given, i.e., radial velocity, profile and intensity variation of several significant lines. An asymmetrical distribution of matter in the envelope surrounding the whole system and having higher density in front of the preceding hemisphere of the B9 star is indicated by the observations. Mass exchange is suggested by the broad and shallow RV minimum presented by the H I and He I shell absorption cores at phases 0.92 to 0.15, which can be explained by a broad jet of matter moving from the B9 star to the companion through the first Lagrangian point. Mass loss is suggested by the increase in the approaching RV observed at phase 0.46, which can be explained by matter flowing through the second Lagrangian point, and by the presence of an extended envelope expanding at constant velocity of about -100 kms^{-1}, where the circumstellar lines of Na I and Ca II are formed. The satellite lines are much less evident in 1971 than in 1958. None of the various absorption or emission features shows any correlation with the invisible companion. (auth)

15202 ROTATIONAL VELOCITIES AND SPECTRAL TYPES FOR A SAMPLE OF BINARY SYSTEMS. Levato, H. (Astronomical Observatory, La Plata). Astron. Astrophys., Suppl. Ser.; 19: No. 1, 91-99(Jan 1975).

Rotational velocities and MK spectral types are determined for the primaries and secondaries of 59 visual binaries and for 88 spectroscopic and eclipsing binaries. (auth)

15203 EQUIVALENT WIDTH DATA FOR SIX GIANTS OF TYPE G AND K. Koelbloed, D.; van Paradijs, J. (Univ., Amsterdam). Astron. Astrophys., Suppl. Ser.; 19: No. 1, 101-113 (Jan 1975).

The equivalent widths of spectral lines for six G- and K-type giant stars, derived from high dispersion spectrograms, are presented. (auth)

15204 NEW APPROACHES TO NEUTRINO ASTROPHYSICS. Fenyves, E. (Univ. of Texas, Dallas); Lande, K.; Bozoki, G.; Frati, W.; Lee, C. K. Ann. N. Y. Acad. Sci.; 224: 333-337(14 Dec 1973).

A search for antineutrino pulses of extraterrestrial origin is described. The antineutrino pulses arise from final stellar gravitational collapse. The experimental design involves the use of two widely separated, well shielded detection stations with correlation of detected events to reduce backgrounds to the very low levels required. The implications of the experiment to delineating the possible sources of gravitational collapse are discussed. (GHT)

15205 X-RAY SOURCES AND THEIR OPTICAL COUNTERPARTS. II. Jones, C.; Forman, W.; Liller, W. (Harvard Coll. Observatory, Cambridge). Sky Telesc.; 48: No. 6, 372-375(Dec 1974).

The binary star system of Hercules X-1, an x-ray source, and its optical counterpart HZ Hercules, a 14th-magnitude variable, is described. Discussion focuses on the irregular behavior (nonperiodic optical flickerings) of HZ Hercules apparently resulting from heating of the primary star by the x-ray companion. X rays from an external source are suggested as a new probe with which to study the structure and physical processes in the atmosphere of a more or less normal star. (BJG)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 15096, 15105, 15390, and 15964.

15206 X-RAY ASTRONOMY. Giacconi, R.; Gursky, H. (eds.). Astrophysics and Space Science Library, Volume 43. Cambridge, MA; D. Reidel Publishing Company, Inc. (1974). 460p. $50.00.

This text contains ten chapters and three appendices. Following an introduction, chapters two through five deal with observational techniques, mechanisms for the production of x rays in a cosmic setting, the x-ray sky and solar x-ray emission. Chapters six through ten include compact x-ray sources, supernova remnants, the interstellar medium, extragalactic x-ray sources and the cosmic x-ray background. Interactions of x rays with matter, units and conversion factors and a catalog of x-ray sources comprise the three appendices. (BJG)

15207 SPECTROPHOTOMETRY OF LOW-REDSHIFT QUASI-STELLAR OBJECTS. Baldwin, J. A. Santa Cruz, CA; Univ. of California (1974). 101p. University Microfilms Order No. 75-8471.

Thesis (Ph. D.).

Emission line strengths, line profiles, and continuum energy distributions have been measured for fourteen quasistellar objects with redshifts z less than 0.3. Most of these QSOs have Seyfert type spectra, in the sense that there are very broad permitted emission lines and narrower forbidden emission lines. It is argued that the broad and narrow emission lines originate in different regions of the gas. The broad line profiles are in good agreement with electron scattering profiles in most, but not all, cases. There appears to be competition between electron scattering and Doppler broadening for the role of the predominant broadening mechanism. The Balmer decrements are found to be fairly steep, and are consistent either with a reddened recombination spectrum or with a recombination spectrum slightly affected by collisional excitations. The latter situation can occur only if the gas lies 300-10,000 pc from the source of the ionizing continuum radiation. The strong Balmer continua rule out pure collisional excitation. The helium abundance in these QSOs is found to be about normal, principally on the basis of the He I lambda 5876 line strengths. The gas in the region which emits the narrow lines also seems to be photoionized. It is possible that very large photon densities in the far ultraviolet seriously alter the forbidden line strengths. The total amount of gas in these H II regions is found to be about 10^3-10^7 M/sub mass/, and might represent the gas normally present in an underlying galaxy. (Diss. Abstr. Int., B)

15208 LUMINOSITY OF QUASI-STELLAR OBJECTS. Colgate, S.A.; Colvin, J.D.; Petschek, A.G. (New Mexico Institute of Mining and Technology, Socorro). Astrophys. J. Lett. 197: No. 3, L105-L108 (1 May 1975).

A model of quasi-stellar objects is described in which infrared and optical photons are produced by the following sequence: supernovae ejecta produce both plasma oscillations and a high electron temperature. The oscillations in turn produce transverse oscillations. These photons are then heated, first by interaction with the plasmons and later by inverse Compton collisions. A luminosity of 10^{47} ergs s^{-1} peaking near 100 μ can be achieved in a dimension of 5×10^{16} to 1×10^{17} cm, given a galactic nucleus of that dimension containing 10^8 stars and a gas density of 10^8 electrons cm^{-3}, and either supernovae or energetic stellar collisions with 50 $M_\odot$ ejecta of several MeV per nucleon energy. (auth)

15209 MILLI-ARCSECOND STRUCTURE OF 3C 84, 3C 273, AND 3C 279 AT 2 CENTIMETER WAVELENGTH. Niell, A.E. (Jet Propulsion Laboratory); Kellermann, K.I.; Clark, B.G.; Shaffer, D.B. Astrophys. J. Lett. 197: No. 3, L109-L112 (1 May 1975).

Long baseline interferometer observations of 3C 84, 3C 273, and 3C 279 show structure on a scale of 1 milli-arcsec which is more complex than can be described by any simple one- or two-component models. Furthermore, for 3C 84 and 3C 273 the structure is not collinear. (auth)

15210 OBSERVATIONS OF COMPACT RADIO NUCLEI IN CYGNUS A, CENTAURUS A, AND OTHER EXTENDED RADIO SOURCES. Kellermann, K.I.; Clark, B.G. (National Radio Astronomy Observatory); Niell, A.E.; Shaffer, D.B. Astrophys. J. Lett. 197: No. 3, L113-L116 (1 May 1975).

Observations of Cygnus A show a compact radio core 2 milli-arsec in extent oriented in the same direction as the extended components. Other large double- or multiple-component sources, including Centaurus A, have also been found to contain compact radio nuclei with angular sizes in the range 1–10 milli-arcsec. (auth)

15211 THE OPTICAL EMISSION-LINE SPECTRUM OF CYGNUS A. Osterbrock, D.E.; Miller, J.S. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. 197: No. 3, 535-544 (1 May 1975).

Spectrophotometric measurements are reported of the radio galaxy 3C 405=Cyg A, made using the image-tube image-dissector scanner on the Lick 120-inch (3 m) telescope. The measurements were reduced to energy units by comparison with scans of standard stars made with the

same system on the same nights. The emission lines and continuum were measured in the spectral region λλ3346–6731 (in the rest system of Cyg A). The interstellar extinction was determined from the measured Balmer-line ratios, assuming a Case B recombination spectrum and the standard Whitford reddening curve, and the measured line and continuum strengths were corrected for this extinction. The corrected line strengths are discussed for the information they contain on the physical conditions and the energy-input mechanism to the ionized gas. Photoionization by stars is ruled out by the great strength of [O I], [N I], and [S II]. Shock-wave heating is ruled out by the [O III] temperature, unless a large amount of ultraviolet ionizing radiation is emitted in the shock. Published calculations of photo-ionization by a synchrotron spectrum, extending far into the ultraviolet, approximately match the observed emission-line spectrum. Likewise, the observed Crab Nebula spectrum approximately matches Cyg A, except for abundance differences, in agreement with the idea that Cyg A is photoionized by a power-law spectrum. (auth)

15212 THE COLLISION OF A STRONG SHOCK WITH A GAS CLOUD: A MODEL FOR CASSIOPEIA A. Sgro, A.G. (Department of Astronomy and Plasma Physics, Columbia University). Astrophys. J. 197: No. 3, 621-634 (1 May 1975).

The result of the collision of the shock with the cloud is a shock traveling around the cloud, a shock transmitted into the cloud, and a shock reflected from the cloud. By equating the cooling time of the posttransmitted shock gas to the time required for the transmitted shock to travel the length of the cloud, a critical cloud density n_c' is defined. For clouds with density greater than n_c', the posttransmitted shock gas cools rapidly and then emits the lines of the lower ionization stages of its constituent elements. The structure of such and its expected appearance to an observer are discussed and compared with the quasi-stationary condensations of Cas A. Conversely, clouds with density less than n_c' remain hot for several thousand years, and are sources of X-radiation whose temperatures are much less than that of the intercloud gas. After the transmitted shock passes, the cloud pressure is greater than the pressure in the surrounding gas, causing the cloud to expand and the emission to decrease from its value just after the collision. A model in which the soft X-radiation of Cas A is due to a collection of such clouds is discussed. The faint emission patches to the north of Cas A are interpreted as preshocked clouds which will probably become quasi-stationary condensations after being hit by the shock. (auth)

15213 ELLIPSOIDAL LIGHT VARIATIONS AND MASSES OF X–RAY BINARIES. Anvi, Y.; Bahcall, J.N. (Institute for Advanced Study, Princeton, New Jersey). Astrophys. J. 197: No. 3, 675-688 (1 May 1975).

The ellipsoidal light curves of four X-ray binaries are analyzed assuming the light variations are caused by gravity-and limb-darkening effects of a tidally distorted star. Some of the uncertainties regarding the validity of this interpretation are pointed out, including possible departures from repeatability in the light curve as well as various theoretical questions. It is shown by numerical calculations of light curves that (*a*) the secondary in Cyg X-1 can be *either* a black hole or a normal early-type star, with $M_2 \geqslant 9M_\odot$; (*b*) for SMC X-1, M_x can be $\sim 2.5M_\odot$; (*c*) for Cen X-3, $0.6 \leqslant M_x \leqslant 1.1M_\odot$; and (*d*) no significant constraints can be derived from the available data for Her X-1. Our results differ from some previously reported investigations because of an improved description of heating effects, allowing the primary to lie inside its Roche lobe, an accurate model calculation of the difference between the two minima, and a fuller allowance for observational uncertainties. (auth)

15214 X–RAY ASTRONOMY IN THE *UHURU* EPOCH AND BEYOND. Kellogg, E.M. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 197: No. 3, 689-704 (1 May 1975).

A review of results from the *Uhuru* satellite is presented. An intensive treatment of two subjects is given, rather than a broad review. First, Cyg X-1, a stellar X-ray source and a candidate for a black hole, is discussed; second, the X-ray source in the Perseus cluster of galaxies, which may be a cloud of hot intergalactic gas, is treated. In both cases, the train of logic used in establishing the nature of these objects is presented and evaluated. For both, while alternative explanations cannot be completely eliminated, they become more difficult to sustain when examined in detail, suggesting that the candidate explanations are more likely correct. (auth)

15215 NATURE OF THE OPTICAL VARIABILITY OF HZ HERCULIS (Her X–1) AND V1357 CYGNI (Cyg X–1). II. Lyutyi, V.M.; Syunyaev, R.A.; Cherepashchuk, A.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 18: No. 6, 684-690 (May 1975).

Photometry of HZ Her near minimum light demonstrates that the system contains an extended bright object surrounding the x-ray source; it is evidently a disk of accreting material. There is a plateau on the light curve lasting $\simeq 2^h$ and corresponding to total eclipse of the disk and of the stellar hemisphere heated by the x rays. At minimum light HZ Her has a $0^m.2$ ultraviolet deficiency compared to main-sequence stars. The shape of the light curve near minimum depends strongly on the 35^d cycle of this star. A long-period ($T < 35^d$) brightness variability exists for the part of the $1^d.7$ light curve near maximum. Both the 35^d cycle and the long-period variability evidently arise because the pulsar beam irradiates the star and the disk primarily first on one side, then on the other. Results are also presented of U, B, V photometry of V1357 Cyg. Here the depth and width of the minima differ at phases 0.0 and 0.5 of the light curve, and a highly irregular brightness variability is superimposed on the periodic variation due to tidal deformation of the visible star. The amplitude of the variability and the absence of x-ray eclipses imply that the visible component fills more than 2/3 of its critical Roche lobe. Mihalas' calculations of a supergiant atmosphere indicate that the luminosity of the visible star does not exceed $2.7 \cdot 10^{37} (M/M_\odot)$ erg/sec. From this circumstance one can show, without any assumptions as to the inclination angle of the orbit, the distance of the system, or the mass of the visible component, that the mass of the proposed black hole Cyg X–1 is at least $3\ M_\odot$. From an expression for the limiting luminosity of the supergiant it is shown that the distance of the system cannot be much more than 2 kpc. (auth)

15216 INFLUENCE OF COMPTON LOSSES ON THE ELECTRON SPECTRUM IN "PLASMA REACTORS". Ochelkov, Yu.P.; Prilutskii, O.F. (Institute for Space Research, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 6, 708-711 (May 1975).

The effects upon the spectrum of electrons in "plasma turbulence reactors" due to energy losses caused by the radiation in the reactor are considered. When these losses are taken into account one no longer obtains a universally valid spectral index for the relativistic electrons in such reactors. (auth)

15217 THE CRAB NEBULA PULSAR AS A BINARY-SYSTEM COMPONENT. Tsygan, A.I. (A. F. Ioffe Physicotechnical Institute, Leningrad). Sov. Astron.–AJ 18: No. 6, 798-799 (May 1975).

The Crab pulsar NP 0532 may be a binary component in a highly elongated elliptic orbit. The parameters of the pulsar orbit are estimated from the observed braking index (as altered by the Doppler effect) of the rotating neutron star. A similar model is proposed to explain x-ray flare sources such as GX333+25(Cen X–4). The influence of precession on observed neutron-star braking indices is discussed. (auth)

15218 ILTHII–ANALYSIS OF THE SPECTRUM OF A THERMAL RADIOASTRONOMICAL SOURCE. Salem, M. (University Coll., London (UK)). Comput. Phys. Commun.; 9: No. 4, 247-257(Apr 1975).

It has been shown by Salem and Seaton (1974) that, given the spectrum of a thermal radioastronomical source, information on the structure can be deduced in the form of a function Ω(E), which is the total angular area within which the emission measure is greater than or equal to E. A spherical model of the object can also be constructed. An estimate of the electron temperature, T_e, (assumed to be constant) is required. In some cases this estimate may be improved by comparing Ω(E) with observations of high angular resolution. The computer program ILTHII (Inverse Laplace Transform–HII region) computes Ω(E) and the spherical model from the flux density spectrum, and also compares Ω(E) with high-resolution observations. (auth)

15219 COMPUTATION OF LINE AND CONTINUUM RADIATION FROM THERMAL RADIOASTRONOMICAL SOURCES. Brocklehurst, M.; Salem, M. (University Coll., London (UK)). Comput. Phys. Commun.; 9: No. 4, 258-267(Apr 1975).

The interpretation of radio recombination lines is of importance to radio astronomy. The computer program described calculates the intensities and profiles of hydrogen and helium radio recombination lines emitted by a thermal source. The electron temperature is assumed to be constant throughout the source, while the electron density is a known function of position. Spherical or plane parallel symmetry is assumed in the program. (auth)

15220 AN INTERPRETATION OF THE REDSHIFT PROBLEM OF QUASAR-GALAXY PAIRS. Obregon, O. (Departamento de Fisica y Quimica, Universidad Autonoma Metropolitana, Unidad Iztapalapa, Mexico); Dehnen, H. (Konstanz Univ. (F. R. Germany)). Astrophys. Space Sci.; 34: No. 2, 481-489(May 1975).

By use of a theoretical scheme presented in a previous publication it is possible to calculate the functional relations among the actual cosmological redshift, the peculiar velocity, and the change of the angular separation for quasar-galaxy pairs. Applying the results to the quasi-stellar object Markarian 205 which seems to be connected with the spiral galaxy NGC 4319 it is found, under the assumption of two different limiting cases, that the distance of the object Markarian 205 is reduced drastically, and that the velocity of one or the two objects remains under 0.1 of the velocity of light if the angle δ between the direction of motion of the quasar and the Earth quasar-galaxy line lies in the range $120° \lesssim \delta \lesssim 180°$. (auth)

15221 SOFT X–RAY SPECTROSCOPY OF THREE EXTRAGALACTIC SOURCES. Margon, B.; Lampton, M. (Space Sciences Laboratory, University of California, Berkeley); Bowyer, S.; Cruddace, R. Astrophys. J. 197: No. 1, 25-29 (1 Apr 1975).

Spectra for 3C 273, M87, and NGC 4151 are presented in the 0.5–5 keV band. The bandwidth of our rocket-borne instrumentation permits information to be derived on absorption in the low energy spectra without the need to normalize to a nonsimultaneous hard X-ray result of a different experiment. None of our spectra require strong self-absorption at a statistically significant level. General techniques for error estimation in parameters of X-ray spectra are discussed, and the results are applied to the spectra previously reported for these objects. It is shown that the χ^2+1 technique which has been used in these analyses can drastically underestimate the magnitude of these errors. We conclude that the suggested division of extragalactic X-ray sources into two groups characterized by the magnitude of absorption in their spectra is premature. (auth)

15222 INTERSTELLAR SCINTILLATION OF EXTRAGALACTIC RADIO SOURCES. Condon, J.J. (National Radio Astronomy Observatory, Charlottesville, Virginia); Backer, D.C. Astrophys. J. 197: No. 1, 31-38 (1 Apr 1975).

Observations of 12 compact extragalactic sources were made at 2695 and 8085 MHz in order to detect weak intensity fluctuations caused by interstellar scintillation. Pulsar data are used to estimate the parameters of the interstellar medium needed to interpret the measured upper limits in terms of source angular diameters which are much larger than the scintillation cutoff diameter. It is shown that the observed source rms brightness temperatures are less than 10^{15} K and 10^{14} K at 2695 and 8085 MHz, respectively, making self-absorbed proton-synchroton radiation and high-brightness coherent mechanisms unlikely. If the sources are composed of "point" components, each source can contain no fewer than 10^4 such components. (auth)

15223 AMPLITUDE-MODULATED NOISE: AN EMPIRICAL MODEL FOR THE RADIO RADIATION RECEIVED FROM PULSARS. Rickett, B.J. (Department of Applied Physics and Information Science, University of California, San Diego). Astrophys. J. 197: No. 1, 185-191 (1 Apr 1975).

The radio radiation received from pulsars shows erratic variations over time and frequency. Experimentally these have been characterized by the autocorrelation function of the observed intensity and radio power spectrum. This paper gives theoretical expressions for these functions, under the assumption that the received radiation is described by random Gaussian noise that has been amplitude modulated. Such a model contains no coherence in time, other than that introduced by interstellar dispersion and the receiver bandpass, and has been implicitly assumed by many observers. The conclusions are a specific test for unresolved pulse components, which are easily confused with system noise, and a test for the significance of pulsar spectrum variations. A subsequent paper will compare observations with this model, in a search for the effects of spatial coherence invoked by many theories of pulsar emission. (auth)

15224 ELECTROMAGNETIC RADIATION FROM COLLIDING BLACK HOLES. Tipler, F.J. (Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 197: No. 1, 199-202 (1 Apr 1975).

It is shown that the collision of two black holes would result in the emission of electromagnetic radiation with a very distinctive wave form. If the gravitational radiation events reported by Weber are produced by black-hole collisions in the galactic center, then the associated electromagnetic pulses would have, in the microwave band, a maximum flux between 4×10^{-6} and 6×10^{-5} Jy. This flux lies at the limit of detectability with present-day radio astronomy technology. (auth)

15225 DETECTION OF NEW STELLAR SOURCES OF VIBRATIONALLY EXCITED SILICON MONOXIDE MASER EMISSION AT 6.95 MILLIMETERS. Snyder, L.E. (Joint Institute for Laboratory Astrophysics, University of Colorado); Buhl, D. Astrophys. J. 197: No. 2, 329-340 (15 Apr 1975).

We have searched 32 selected sources for $v=1$, $J=1\rightarrow0$ SiO maser emission at 43,122.0 MHz($\sim$6.95 mm), and detected 16 of them. Two of them, Ori A and W Hya, had been detected previously by Thaddeus *et al.* We detected eight of the SiO $v=1$, $J=2\rightarrow1$SiO maser sources observed by Kaifu, Buhl, and Snyder at 86,243.27 MHz ($\sim$3.48 mm), and found that the $v=1$, $J=1\rightarrow0$ maser is often the most intense transition, and hence promises to be the best frequency to use in searching for new maser sources. Most of the detected maser sources reported in this paper can readily be associated with known late-type stars; therefore we have been able to analyze the velocity patterns and stellar classification implications found from our data. The proposed maser mechanisms are discussed in the context of current observations. (auth)

15226 TEMPERATURE AND EMISSION-LINE STRUCTURE AT THE EDGES OF H II REGIONS. Mallik, D.C.V. (Washburn Observatory, University of Wisconsin). Astrophys. J. 197: No. 2, 355-363 (15 Apr 1975).

Models of ionization fronts located at the edges of expanding H II regions are presented. These fronts are of the weak D-type and are preceded by shocks in the H I clouds. Since the energy input time is smaller than the cooling time, the gas is found to heat up to a high temperature immediately following ionization. At the trailing edge of the front, the temperature decreases and the ionized gas merges with the main bulk of the nebula where the physical processes are in equilibrium. The emission in [O II] and [N II] lines is greatly enhanced because of the high temperature at the front. The emission in these and other important lines is calculated and compared with Hβ. Effects of different velocities of flow, of different exciting stars, and of different gas densities on the structure of the fronts are also investigated. Observations of bright rims of H II regions where enhanced emission of [N II] lines has been reported are discussed on the basis of these models. (auth)

15227 RESULTS OF X—RAY AND OPTICAL MONITORING OF SCORPIUS X-1 IN 1970. Mook, D.E.; Messina, R.J. (Department of Physics and Astronomy, Dartmouth College); Hiltner, W.A.; Belian, R.; Conner, J.; Evans, W.D.; Strong, I.; Blanco, V.M.; Hesser, J.E.; Kunkel, W.E.; Lasker, B.M.; Golson, J.C.; Pel, J.; Stokes, N.R.; Osawa, K.; Ichimura, K.; Tomita, K. Astrophys. J. 197: No. 2, 425-441 (15 Apr 1975).

Scorpius X-1 was monitored at optical and X-ray wavelengths from 1970 April 26 to 1970 May 20. The optical observations were made at six observatories around the world, and the X-ray observations were made by the *Vela* satellites. There was a tendency for the object to show greater variability in X-ray emission when the object was optically bright. The intensity histograms for both the optical and X-ray observations are discussed, as well as periodic variations in the optical intensity. (auth)

15228 THE X—RAY, OPTICAL, AND RADIO BEHAVIOR OF SCORPIUS X-1: THE 1971 COORDINATED OBSERVATIONS. Bradt, H.V. (Center for Space Research, MIT, Cambridge, Massachusetts); Braes, L.L.E.; Forman, W.; Hesser, J.E.; Hiltner, W.A.; Hjellming, R.; Kellogg, E.; Kunkel, W.E.; Miley, G.K.; Moore, G.; Pel, J.W.; Thomas, J.; Vanden Bout, P.; Wade, C.; Warner, B. Astrophys. J. 197: No. 2, 443-455 (15 Apr 1975).

Scorpius X-1 has been monitored at radio, optical, and X-ray wavelengths for 21 days during the period 1971 February 23 through 1971 April 2. The *Uhuru* satellite was used for the X-ray observations. The X-ray intensity was found to fluctuate rapidly (time constants <6 minutes) by a factor of about 2 during periods when the object was in a bright and flaring optical state. The X-ray flux was constant to within $\sim$5 percent during the faint and relatively quiescent optical periods. No correlation between the X-ray/optical activity and radio flaring was noted. (auth)

15229 THE X—RAY, OPTICAL, AND RADIO BEHAVIOR OF SCORPIUS X-1: THE 1972 COORDINATED OBSERVATIONS. Canizares, C.R.; Clark, G.W.; Li, F.K.; Murthy, G.T.; Bardas, D.; Sprott, G.F.; Spencer, J.H. (Massachusetts Institute of Technology); Mook, D.E.; Hiltner, W.A.; Williams, W.L.; Moffett, T.J.; Grupsmith, G.; Vanden Bout, P.A.; Golson, J.C.; Irving, C.; Frohlich, A.; van Genderen, A.M. Astrophys. J. 197: No. 2, 457-466 (15 Apr 1975).

We present the results of a 10-day observation of Scorpius X-1 involving seven optical stations, NRAO, and the MIT experiment on the OSO 7 satellite. The source exhibits all of its characteristic variability, including flares and quiescent periods. There is clear evidence for an X-ray-optical correlation in that X-ray activity occurs only where the object is brighter than $m_B\simeq12.7$. However, detailed comparisons of X-ray and optical flares do not show a strict correlation between the intensities, with the exception of one $\sim$20-minute X-ray flare which lags 2 to 3 minutes behind a triple optical flare of similar overall duration. There is no apparent correspondence between two radio flares observed and the shorter wavelength activity. (auth)

15230 RADIAL VELOCITIES OF SCORPIUS X-1. Crampton, D.; Cowley, A.P. (Dominion Astrophysical Observatory). Astrophys. J. 197: No. 2, 467-469 (15 Apr 1975).

Radial velocity and intensity measurements are presented for the following emission lines of Scorpius X-1: He II λ4686, the C III blend near λ4650, Hβ, and Hδ. Analysis of these data suggests that a periodicity near $0^d.27$ may be present, but our data do not confirm the periods ($3^d.931$, $3^d.7400$, and $0^d.7873$) recently suggested. If the velocity variation represents orbital motion, a model similar to an old nova is inferred. The X-ray flux might be accounted for by a rapid rate of mass transfer. (auth)

15231 CHANGE IN THE HIGH-ENERGY RADIATION FROM THE CRAB. Greisen, K.; Ball, S.E. Jr.; Campbell, M.; Gilman, D.; Strickman, M. (Laboratory of Nuclear Studies, Cornell University); McBreen, B.; Koch, D. Astrophys. J. 197: No. 2, 471-479 (15 Apr 1975).

On 1973 July 23, the Cornell γ-ray telescope had a second exposure to the Crab Nebula and pulsar via balloon flight from Palestine, Texas. On the previous flight, 1971 October 6, the signal from the pulsar had been unmistakably clear, especially at the highest energies ($>$800 MeV), and an unpulsed component of similar average power had also been discernible. On the second flight, despite higher altitude, longer exposure, and improved electronics, the pulsed signal was barely detectable and the DC component not observable at all. The drop in

intensity seems to increase with energy, being only a factor of 2 at 200 MeV but an order of magnitude at 1 GeV. There is some indication (not compelling) that the γ-ray flux may have changed even within the 6-hour exposure. The first flight may have viewed the Crab in a state of enhanced high-energy emission correlated with the glitches that occurred on 1971 August 1 and October 25. (auth)

15232 PULSAR FLUCTUATION SPECTRA AND THE GENERALIZED DRIFTING-SUBPULSE PHENOMENON. II. Backer, D.C. (Goddard Space Flight Center, Greenbelt, Maryland); Rankin, J.M.; Campbell, D.B. Astrophys. J. 197: No. 2, 481-487 (15 Apr 1975).

Pulsar observations at meter wavelengths have been analyzed to investigate pulse-to-pulse variations and to identify regions of the pulse profile which display distinct statistical properties. Fluctuation spectra of eight recently discovered pulsars are presented along with a description of the drifting-subpulse phenomenon in several objects with quasi-periodic responses in their fluctuation spectra. A quantitative analysis of the drifting-subpulse phenomenon in PSR 0031-07 and PSR 0809+74 is given which emphasizes the broad-band nature of the phenomenon. A summary of the memory exhibited by pulsars with time scales of ~50 periods is given. (auth)

15233 FARADAY ROTATION NEAR CHARGED BLACK HOLES AND OTHER ELECTROVACUUM GEOMETRIES. Gerlach, U.H. (Department of Mathematics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 11: No. 10, 2762-2769 (15 May 1975).

In space permeated by a steady background electromagnetic field a gravitational wave and an electromagnetic wave not only undergo beat frequency oscillations, but the linear polarizations of these waves undergo Faraday rotations as well. The beating and the Faraday rotations are inextricably related. The classification of these phenomena requires three parameters, the three Euler parameters of SU(2). They specify in a more general sense the "polarization" of an electrograviton mode. The evolution of the beat frequency oscillations and the Faraday rotations along a propagating wave front is described as a moving point in SU(2). Consequently, a charged black hole serves not only as a catalyst for converting suitably directed electromagnetic radiation into gravitational radiation, but also as an agent that randomized the linear polarizations of radiation emerging from it. An assessment of these phenomena in relation to the origin of Weber's signals is given. (auth)

15234 MASSIVE BLACK HOLES IN EXTRAGALACTIC RADIO SOURCE COMPONENTS. Rees, M. J. (Cambridge Univ., Eng.); Saslaw, W. C. Mon. Not. R. Astron. Soc.; 171: No. 1, 53-57(Apr 1975).

Mechanisms are discussed whereby massive black holes, ejected from galactic nuclei, might conceivably travel through the rarefied intergalactic gas, and release the necessary energy over relevant time scales to explain extragalactic double radio sources. (auth)

Solar Phenomena

Refer also to abstracts 15086, 15090, 15092, 15093, 15097, 15392, 15419, 15465, and 15635.

15235 (N-74-34262) SOLAR PROCESSES AND THEIR OBSERVATIONS. Slonim, Yu. M. (ed.). Oct 1974. Translation of Solnechnye protsessy i ikh nablyudeniya, Fan Press, Tashkent, 1973. (NASA-TT-F-15749). 190p. NTIS $12.50.

Investigations of the physics, dynamics, and interrelations of processes which develop in active regions of the sun are described, along with an analysis of apparatus applicable for solar observations and the conditions of the observations themselves. A model of the inhomogeneous chromosphere was also developed. (auth)

15236 (SAND-75-0146) SUMMARY OF SOLAR ECLIPSE OPERATIONS IN AUSTRALIA, JUNE 1974. Lathrop, L. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 9p. Dep. NTIS $4.00.

During the solar eclipse of June 20, 1974, a team of scientists and engineers from the United States and Australia conducted a series of scientific observations to study the temperature distribution in the solar corona. The performance of the rocket launched experiments is summarized. Two identical experiments were launched. Both rocket systems performed nominally. One failed to acquire the sun before entry into the shadow. Film from the recovered payload verified that the sun was not in view. The other test appeared to point successfully at the sun. However, the payload was not recovered and no data were obtained. The probable cause of the failures is discussed. (GHT)

15237 BEHAVIOR OF THE RED OXYGEN EMISSION LAMBDA 6300 A DURING THE SOLAR AND GEOMAGNETIC DISTURBANCE ON OCTOBER 27-30, 1973. Gogosheva, T.; Gogoshev, M. (Astronomical Observatory, Stara Zagora, Bulgaria). Compt. Rend. Acad. Bulg. Sci.; 27: No. 12, 1659-1662(1974).

Observations were carried out during a period of solar and geomagnetic disturbance at the Astronomical Observatory near Stara Zagora with a zenith tilting photometer for studying the oxygen emissions lambda 6300A, lambda 5577A and the sodium line lambda 5893A. Unusual changes in the intensity of lambda 6300A were noted. The effects observed could be explained by the existence of a dissipating flux of auroral electrons which is periodically accelerated in the region of the ring current and precipitating into the atmosphere above the mid latitudes. (BJG)

15238 FUNDAMENTAL ASTRONOMY. Solar System and Beyond. Cole, F. W. New York; John Wiley and Sons, Inc. (1974). 490p.

This text is divided into three sections. The first deals with the historical perspective, motion of the earth and sky, the concept of time and the laws of motion. The solar system is the topic of part two with chapters on the earth, moon, planets, lesser bodies of the solar system and the sun. Part three concerns the structure and properties of stars and galaxies including determination of stellar properties, statistical methods and stellar evolution, content and organization of the universe as well as other phenomena. There are eight appendicies and a glossary. (BJG)

15239 A MODEL FOR THE ORIGIN OF SOLAR WIND STREAM INTERFACES. Hundhausen, A.J. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado 80302); Burlaga, L.F. J. Geophys. Res. 80: No. 13, 1845-1848 (1 May 1975).

The basic variations in solar wind properties that have been observed at 'stream interfaces' near 1 AU are explained by a gas dynamic model in which a radially propagating stream, produced by a temperature variation in the solar envelope, steepens nonlinearly while moving through interplanetary space. The region thus identified with the stream interface separates the ambient solar wind from the fresh hot material originally in the stream. However, the interface regions given by the present model are thicker than most stream interfaces observed in the solar wind, a fact suggesting that some additional physical process may be important in determining that thickness. Variations in the density, speed, or Alfvén pressure alone appear not to produce streams with such an interface. (auth)

15240 A TWO-COMPONENT DESCRIPTION OF ENERGETIC PARTICLE SCATTERING IN A TURBULENT MAGNETOACTIVE PLASMA. Morfill, G. (Max-Planck-Institut fur Physik und Astrophysik, Institut fur extraterrestrische Physik, Garching, Germany). J. Geophys. Res.; 80: No. 13, 1783-1794(1 May 1975).

The problem of resonant scattering of charged particles in a turbulent plasma is described in terms of a simplified diffusion coefficient which allows a good quantitative estimate to be made of the pitch angle diffusion coefficient and the spatial diffusion coefficient for a general case of a wave k vector distribution which is anisotropic and not necessarily field aligned. The simplified expression derived for the diffusion coefficient takes advantage of the fact that the quasi-linear theory gives an analytic expression in all those cases where the wave k vector distribution is a delta function. The full k vector distribution is represented as the sum of two weighted delta function approximations, one of which is parallel to the average magnetic field B_0 and the other, parallel to the direction of maximum k vector density A. The component parallel to B_0 turns out to be very important when the k vector distribution is very asymmetric, i.e., the angle between A and B_0 is large. In principle, one can use any functional dependence of the k vector density distribution, but for illustration purposes this paper uses the simplest form. The two-component description is derived in this paper, and the results are applied to the solar cavity by using the theory of Voelk et al. (1974). (RWR)

15241 INTERPLANETARY ACCELERATION OF LOW-ENERGY SOLAR PROTONS: A STUDY OF THE SOLAR PARTICLE EVENT OF NOVEMBER 18, 1968. Venkatarangan, P. (Division of Physics, National Research Council of Canada, Ottawa, Ontario, Canada); Lanzerotti, L.J. J. Geophys. Res. 80: No. 13, 1744-1750 (1 May 1975).

The spectra of solar proton and alpha particle fluxes from the solar particle event of November 18, 1968, deviate considerably from a power law form for as long as 2 days after the onset of the event. The spectral distortions are observed to progressively diminish with time. The departures in the spectral shape are not entirely attributable to diffusive velocity dispersion of the solar particles. Several lines of possible interpretation, taking into consideration effects of particle storage in the corona and the acceleration and deceleration of particles in the interplanetary medium, are discussed. It is suggested that acceleration of solar protons and alpha particles in the interplanetary medium is perhaps occurring. The time scales for the acceleration of protons in the energy range 0.6-2.0 MeV are derived. (auth)

15242 LUNAR SURFACE SOLAR WIND OBSERVATIONS AT THE APOLLO 12 AND APOLLO 15 SITES. Clay, D.R.; Goldstein, B.E.; Neugebauer, M.; Snyder, C.W. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Geophys. Res. 80: No. 13, 1751-1760 (1 May 1975).

Eleven months of simultaneous data were obtained by the Alsep solar wind spectrometers at the Apollo 12 and 15 sites. There were no observed differences between the properties of the upstream solar wind and the plasma observed at Apollo 15, where the local magnetic field is 3 ± 3 γ. However, the solar wind flow is often strongly perturbed at the Apollo 12 site, where the field is ~ 38 γ. These perturbations include (1) the acceleration of solar wind electrons to energies of ≤ 120 eV, (2) the deceleration of solar wind protons by as much as 70 km/s, (3) the deflection of solar wind protons by $\leq 10°$, (4) the focusing or defocusing of the ion flux by factors as large as 3, (5) the heating of the protons by a factor of ≤ 2 in excess of any adiabatic heating associated with compression, and (6) an increased level of fluctuations of plasma parameters with frequencies in the range 3×10^{-5} to $>2\times10^{-2}$ Hz. The deceleration and focusing are both functions of the angle of incidence of the plasma and of the component of solar wind dynamic pressure normal to the surface. These effects require that there be a charge-separation electric field above the lunar surface and that the magnetic field at the Apollo 12 site have a scale size of less than ~ 5 km. The plasma perturbations observed at this site suggest that remanent lunar magnetic fields are the cause of lunar limb compression waves and that these waves should be more noticeable for low solar wind dynamic pressures. Those physical and chemical properties of the surface layers of the moon which depend on the chemical composition, the energy, or the flux of the bombarding plasma may depend strongly on the strength and scale size of the local magnetic field. (auth)

15243 AN EXTENSION OF THE USE OF CRITICAL CONDITIONS IN SOLAR WIND THEORY. Gussenhoven, M.S.; Carovillano, R.L. (Department of Physics, Boston College, Chestnut Hill, Massachusetts 02167). J. Geophys. Res. 80: No. 13, 1761-1763 (1 May 1975).

This paper is based upon the polytropic Parker model of the solar wind. The critical condition is a regularity requirement for a transonic solution and represents a contraint upon the flow temperature and velocity. This constraint may be imposed at any distance, and this freedom enables us to present the family of all solutions to the flow equations, for each value of the polytrope index γ, in a way that facilitates comparison to experimental solar wind values. The solutions for $\gamma=7/5$ are treated analytically, and the results are generalized for other values of the polytrope index. One result is to display the limitations of the polytrope model in satisfying experimental requirements simultaneously at 1 AU and near the sun. The observed dependence of temperature on flow speed at 1 AU is fairly well represented by the model if the one-fluid temperature is taken to be the average of the observed electron and proton temperatures and if $\gamma\simeq1.2$. (auth)

15244 THE MYSTERY OF THE COSMIC BORON ABUNDANCE. Ramadurai, S. (Tata Inst. of Fundamental Research, Bombay (India)); Wickramasinghe, N. C. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 33: No. 2, L41-L44(Apr 1975).

The observed high abundance of boron in type I carbonaceous chondrites may be due to the presence in the primitive solar nebula of graphite grains which have been irradiated by high-energy nucleons at some stage of their history. The boron atoms thus produced by spallation reactions are stably locked within interstellar graphite grains and could make a significant contribution to the boron abundance of CI chondrites. (auth)

15245 FORMALDEHYDE POLYMERS IN COMETS. Vanysek, V. (Manchester Univ. (UK)); Wickramasinghe, N. C. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 33: No. 2, L19-L28(Apr 1975).

The possibility that crystalline formaldehyde polymers are present in cometary dust is discussed. In common with most other parent molecules proposed for comets, $(H_2CO)_n$ is difficult to detect, even if it is present in relatively high concentrations. The optical properties of these polymers in the visual and infrared regions are similar to those of silicate grains, and crystalline formaldehyde polymers provide no emission at 6 cm wavelength. The lifetime of gaseous H_2CO in the solar radiation field is too short, and the expected transitions in the microwave region would be too weak to be detected. However, the available data concerning the physical properties of comets indicate that polymerized formaldehyde cannot be ruled out as a major constituent of cometary material. (auth)

15246 ULTRAVIOLET SOLAR SPECTRUM (1889-1969 ANGSTROEMS). McAllister, H. C. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy); Smith, P. H. (Hawaii Univ., Honolulu (USA)). Sol. Phys.; 41: No. 1, 3-16(Mar 1975).

Six spectrograms of the solar spectrum were obtained in the region from 1800 to 1970 Å at a resolving power of about 2×10^5, using a rocket-borne spectrograph with an echelle as the principal dispersing element. Data reduction has been completed for the region from 1889 to 1969 Å, in which 732 features have been measured and tabulated along with available laboratory wavelengths which correspond reasonably with the solar features. Tracings of the spectra are also presented. (auth)

15247 ON THE EFFECT OF LATITUDE DEPENDENT BASE CONDITIONS ON THE STRUCTURE OF THE SOLAR WIND. Roxburgh, I. W.; Singer, C. (Queen Mary Coll., London (UK)). Sol. Phys.; 41: No. 1, 241-245(Mar 1975).

The isothermal solar wind equations are solved for the case where the coronal conditions vary with latitude. It is found that the solutions are not uniquely determined by the base density but require knowledge of the injection angle of the fluid. Even for the case of spherically symmetric density at the corona, the solutions are not unique and form a one parameter set, but the latitude variation decreases rapidly with increasing heliocentric distance. (auth)

15248 ON CORONAL STREAMERS WITH T-TYPE NEUTRAL POINTS. Durney, B. R. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Sol. Phys.; 41: No. 1, 233-240 (Mar 1975).

The gas-magnetic field interaction of an isothermal axisymmetric corona is considered. A method is suggested for solving the MHD equations in the case when a uniform gas pressure and the radial component of the magnetic field (as in a dipole) are specified at the Sun's surface. The flux of open field lines (ϕ) can be given arbitrarily, and no reconnection or opening of field lines can take place. If configurations in hydrostatic equilibrium between the regions of open and closed field lines can be found, then the method of solution converges. The equation of hydrostatic equilibrium at the neutral point (assumed to be of the T-type) is written in a simple form, and it is shown that if ϕ is smaller than a certain ϕ_{min}, this equation cannot be satisfied. Configurations in hydrostatic equilibrium between the regions of open and closed field lines are expected to exist for any value of ϕ larger than ϕ_{min}. (auth)

15249 THE RELATIONSHIP BETWEEN SOLAR FLARES AND SOLAR SECTOR BOUNDARIES. Dittmer, P. H. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Sol. Phys.; 41: No. 1, 227-231(Mar 1975).

A superposed epoch analysis of 1964-1970 solar flares shows a marked increase in flare occurrence within a day (13° of longitude) of ($\mp$) solar sector boundaries as well as a local minimum in flare occurrence near ($\mp$) sector boundaries. This preference for ($\mp$) boundaries is more noticeable for northern hemisphere flares, where these polarities match the Hale polarity law, but is not reversed in the south. Plage regions do not show such a preference. (auth)

15250 TABULATION OF THE HARMONIC COEFFICIENTS OF THE SOLAR MAGNETIC FIELDS. Altschuler, M. D.; Trotter, D. E.; Newkirk, G. Jr. (High Altitude Observatory, Boulder, Colo. (USA)); Howard, R. (Hale Observatories, Pasadena, Calif. (USA)). Sol. Phys.; 41: No. 1, 225-226(Mar 1975).

Tables of spherical harmonic coefficients for the global photospheric magnetic field between 1959 and 1974 are now available on microfilm. (These are the same coefficients which were used to construct the maps of the coronal magnetic atlas.) (auth)

15251 THE VARIATION OF SOLAR PROTON ENERGY SPECTRA AND SIZE DISTRIBUTION WITH HELIOLONGITUDE. Van Hollebeke, M. A. I.; Ma Sung, L. S.; McDonald, F. B. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 41: No. 1, 189-223 (Mar 1975).

A statistical study of the initial phases of 185 solar particle events has been carried out using the data from the Goddard cosmic-ray experiments on IMPs IV and V. Special emphasis is placed on the identification of the associated solar flare. The parent flare can be determined for 68% of the events. It appears probable that most of the unidentified increases occur on the non-visible disc of the Sun. The existence of a "preferred-connection" longitude between 20°W and 80°W is established by examining the heliolongitude of all the flare associated events. While power law in differential kinetic energy appears to give the best representation it cannot be distinguished from exponential in rigidity over the limited range of 20 to 80 MeV. It is argued that for heliolongitudes $\lambda_\odot = 20$ to 80°W, γ_p, the spectral index determined at the time of maximum particle intensity is representative of the source spectra. For these heliolongitudes γ_p displays a surprisingly small range with magnitudes varying mainly between 2.0

and 3.1. At lower energies γ_p is smaller. Previous electron measurements provide almost identical average values of the source spectra over similar energy ranges. These results are discussed briefly in terms of Fermi acceleration models. For flare events located further away from the nominal field line connecting the Earth and the Sun, γ_p becomes progressively steeper. The lower energies (4 to 20 MeV) do not exhibit this behaviour. It is argued that this spectral steepening at the higher energies is the result of energy-dependent escape during the coronal diffusion process. The size distribution can be represented by a power law of the form $dN/dI = I^{-\alpha}$, where N is the number of events per unit intensity and I is the maximum particle intensity at a given energy (usually taken at 40 MeV) with $\alpha \sim 1.15 \pm 0.1$. The same value of α applies to both eastern and western hemisphere events. The event size, on the average, appears to decrease approximately two orders of magnitude for each 60° away from the preferred connection region. (auth)

15252 DECAMETER STORM RADIATION. II. Gergely, T. E.; Kundu, M. R. (Maryland Univ., College Park (USA)). Sol. Phys.; 41: No. 1, 163-188(Mar 1975).

The physical properties of six decametric storms, observed at Clark Lake Radio Observatory, are studied. The height of the storm continuum sources was determined from the rotation rate. Assuming that the radiation originates at the plasma frequency the gradient of electron density for the regions where the storms originate was computed. The mean angular size of the decametric continuum sources is large; it increases with decreasing frequency. The storm continuum is found to be strongly directive toward the disk center. The east–west asymmetry, well observed at meter wavelengths, is also observed at decameter wavelengths. The occurrence of two distinct classes of Type III bursts in storms is discussed: "off-fringe" and "on-fringe" Type III's. The "off-fringe" III's are found to be displaced in position from the continuum source; on the other hand, the "on-fringe" ones coincide in position with the continuum. These two kinds of bursts differ in other properties as well. A model of the storm region is proposed. The continuum radiation and the "on-fringe" Type III's are believed to originate above closed magnetic loops, in regions of diverging field lines; the "off-fringe" Type III's are thought to be excited by energetic electron streams, having access to open magnetic field lines at the base of the loops. (auth)

15253 TIME PROFILE OF TYPE III BURSTS. Takabura, T.; Naito, Y.; Ohki, K. (Tokyo Univ. (Japan)). Sol. Phys.; 41: No. 1, 153-161(Mar 1975).

On the hypothesis that the time profile of a Type III burst corresponds directly to the flux of electron beam, the similarity of time profile is shown to be maintained even if the electron velocity decreases with distance provided that the time is normalized to unity at the time of maximum flux. The observed time profiles of Type III bursts with simple shape seem to follow the similarity law in almost all frequency ranges. This evidence may indicate that the time profile, both the rising and decaying phases, of a Type III burst should be attributed to a common origin, e.g., the time variation of exciter determined by the initial velocity distribution in the electron beam, instead of attributing the rising time to the beam length and the decay time to the damping of plasma waves after the passage of the electron beam. (auth)

15254 THE HEIGHT DISTRIBUTION OF FLARE HARD X-RAYS IN THICK AND THIN TARGET MODELS. Brown, J. C.; McClymont, A. N. (Glasgow Univ. (UK)). Sol. Phys.; 41: No. 1, 135-151(Mar 1975).

38 refs.

The current controversy between thick and thin target models of hard x-ray flares is reviewed and it is concluded that the most promising method of distinguishing them is in terms of the differences in the distribution of the source with height in the solar atmosphere. Quantitative predictions are made of this height distribution for both models and the results discussed in relation to observations of hard x-ray emission from flares behind the limb. It is concluded that the thick target model is as compatible with such events as the thin target whereas the latter is in general much less satisfactory in terms of energy requirements and of flare observations at other wavelengths. Other source models are also briefly considered. (auth)

15255 HIGH RESOLUTION OBSERVATIONS OF SOLAR BURSTS AT 3.7 AND 11.1cm WAVELENGTHS. Alissandrakis, C. E.; Kundu, M. R. (Maryland Univ., College Park (USA)). Sol. Phys.; 41: No. 1, 119-133(Mar 1975).

Four bursts were observed on August 9, 1973 with the NRAO 3-element interferometer at 3.7 and 11.1 cm. By using a simple source model we have calculated the temperature, flux, size, and position of the small scale components of the bursts as a function of time. Peak temperatures around 10^7K for the components with size of about 10″ at 11.1 cm and 3″ at 3.7 cm were obtained. The peak flux of these components lies between 4 and 40% of the total peak flux of the bursts. Two of the bursts were found to be right circularly polarized. There is evidence that the location of these two bursts does not coincide with the location of the brightest point of the associated active regions. The existence of burst structures with temperatures of the order of 10^7K indicates that at least part of the radiation in these bursts is generated by a nonthermal mechanism. (auth)

15256 SHORT-LIVED FLARE-LIKE PHENOMENA IN THE QUIET CHROMOSPHERE. Glackin, D. L. (Hale Observatories, Pasadena, Calif. (USA)). Sol. Phys.; 41: No. 1, 115-118(Mar 1975).

Objects resembling small and intense flares that last on the order of tens of minutes and seem to be unrelated to other activity have been observed. They are strikingly evident in full-disc Hα cinematograms. (auth)

15257 ON THE IDENTIFICATION OF Fe IX AND Ni XI LINES FROM CORONAL SPECTRA. Magnant-Crifo, F. (Observatoire de Paris, Section de Meudon, 92 (France)). Sol. Phys.; 41: No. 1, 109-113(Mar 1975).

Identifications of coronal lines with transitions of Fe IX and Ni XI, as proposed by Wagner and House, and Svenson, Ekberg and Edlen, are checked by means of line intensity ratios, from observations obtained at the 1965 eclipse. All the suggestions of Svenson, Ekberg, and Edlen are suitable. (auth)

15258 ENHANCEMENT OF THE SOLAR X-RAY LINE INTENSITIES DUE TO DIELECTRONIC RECOMBINATION AS AN EXCITATION PROCESS. Razaullah Ansari, S. M.; Alam, B. (Aligarh Muslim Univ. (India). Dept. of Physics). Sol. Phys.; 41: No. 1, 97-107(Mar 1975).

Intensities of resonance lines in the x-ray region for Si IX–Si XIV ions are calculated by considering total excitation, i.e., excitation due to electron impact and dielectronic recombination. It is found that the contribution of the latter is quite significant. For consistency, the electron density effect in the calculations is not only accounted for in the ionization equilibrium but also in the total rate of excitation. It is also found that the contribution of electron density effect is pronounced with the inclusion of dielectronic recombination as an excitation mechanism. The computed average line intensities are compared with the available observations and a table of line flux for various wavelengths of the above-mentioned ions at different temperatures is also given. (auth)

15259 ON A COLD EMISSION IN THE SOLAR CORONA. Alikayeva, K. V. (AN Ukrainskoj SSR, Kiev). Sol. Phys.; 41: No. 1, 89-95(Mar 1975).

The faint emission of hydrogen, helium, and metals in the corona which appeared near an active prominence is studied. The calculations showed that the temperature of the emission region is in the limits from 10,000 to 30,000 K and the electron density is between 10^9 and 10^{10} cm^{-3}, respectively. (auth)

15260 UMBRAL OSCILLATIONS AND PENUMBRAL WAVES IN Hα. Moore, R. L.; Tang, F. (Hale Observatories, Pasadena, Calif. (USA)). Sol. Phys.; 41: No. 1, 81-88(Mar 1975).

Examples of umbral oscillations observed on Big Bear Hα filtergram movies are presented and the relation between umbral oscillations and running penumbral waves occurring in the same sunspot is investigated. Umbral oscillations near the center of the umbra are probably physically independent of the penumbral waves because the period of these umbral oscillations (150 s) is shorter than the penumbral wave period (270 s) but not a harmonic. Dark puffs are also reported which emerge from the edge of the umbra and move outward across the penumbra, and which have the same period as the running penumbral waves. These dark puffs are interpreted to be the extension of chromospheric umbral oscillations at the edge of the umbra. It is suggested that the dark puffs and the running penumbral waves have a common source: photospheric oscillations just inside the umbra. (auth)

15261 Hα OSCILLATIONS IN SUNSPOT UMBRAE. Phillis, G. L. (Lockheed Solar Observatory, Burbank, California (USA). Sol. Phys.; 41: No. 1, 71-79(Mar 1975).

Direct measurement of intensity and photographic subtractions of simultaneous Doppler filtergrams at Hα ± 0.3 Å in a time-lapse sequence of McMath 11482 has shown velocity oscillations in sunspot umbrae. These oscillations exhibit the following characteristics: (a) A characteristic oscillation frequency for each umbra, with the periods ranging from 145 ± 10 s to 180 ± 10 s. (b) A duration of at least 8 cycles. (c) A Doppler shift of 10 km s^{-1}. (d) An oscillating element size of 3″ or less. (e) A visibility to a radius vector of about 0.9. (auth)

15262 THE SOLAR NIOBIUM ABUNDANCE. Hauge, O.; Youssef, N. H. (Oslo Univ.). Sol. Phys.; 41: No. 1, 67-69 (Mar 1975).

The solar Nb abundance is derived from five NbI and ten NbII lines in the photospheric spectrum. Equivalent widths are obtained from measurements on spectra recorded at Kitt Peak National Observatory. Synthetic spectrum calculations gave abundances of 2.23 and 2.08 from neutral and ionized lines respectively in the logarithmic $A_H = 12.00$ scale. This gives an average abundance value of $A_{Nb} = 2.13 \pm 0.10$. (auth)

15263 THE SOLAR LITHIUM ABUNDANCE. II. Synthetic Analysis of the Solar Lithium Feature at λ 6707.8 A. Mueller, E. A.; Peytremann, E.; Reza, R. de la (Observatoire de Geneve, Switzerland). Sol. Phys.; 41: No. 1, 53-65(Mar 1975).

The solar abundance of lithium and its isotopic abundance ratio were determined by comparing synthetic spectra with the high quality center-to-limb spectra of the solar lithium feature presented in Paper I by Brault and Muller (1974). The following possible effects on the abundance result were considered: deviations from LTE, atmospheric models, blends by molecular and atomic lines, hyperfine structure, large-scale velocity fields. It was found that the photospheric lithium abundance is $\log\epsilon_{Li} = 1.0 \pm 0.1$. The greatest uncertainty is due to differences in the atmospheric models. The NLTE abundance result is 0.05 dex smaller than the LTE value. A mean depth of line formation was determined for the Li^7 Iλ6707.776 Å line. The lithium isotopic abundance ratio was found to be $Li^6/Li^7 \leq 0.01$. (auth)

15264 THE SOLAR LITHIUM ABUNDANCE. I. Observations of the Solar Lithium Feature at λ 6707.8A. Brault, J. W. (Kitt Peak National Observatory, Tucson, Ariz. (USA)); Mueller, E. A. (Observatoire de Geneve, Switzerland). Sol. Phys.; 41: No. 1, 43-52(Mar 1975).

A detailed observational study of the solar photospheric lithium feature has been carried out with emphasis on center-limb observations, continuum location, possible effects of telluric lines, effects of blending by atomic and molecular lines, and decomposition of the solar spectrum around λ6707 Å. (auth)

15265 ACOUSTIC WAVES IN THE LOWER SOLAR ATMOSPHERE. Chiuderi, C.; Giovanardi, C. (Osservatorio Astrofisico de Arcetri, Florence (Italy)). Sol. Phys.; 41: No. 1, 35-42 (Mar 1975).

The propagation and dissipation of acoustic waves in the lower solar atmosphere is studied. The level of shock formation is computed for various initial conditions. It is shown that shocks form rather low in the atmosphere and that this result does not depend critically on the assumed initial conditions. (auth)

15266 ONE- AND MULTI-COMPONENT MODELS OF THE UPPER PHOTOSPHERE BASED ON MOLECULAR SPECTRA. IV. Non-LTE Treatment of the CN Violet System. Mount, G. H.; Linsky, J. L. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). Sol. Phys.; 41: No. 1, 17-33(Mar 1975).

Non-LTE synthetic spectra derived from a detailed analysis of the formation of the CN(0,0) λ3883 Å spectrum are compared with center-limb photoelectric spectra taken at Kitt Peak National Observatory. Significant non-LTE effects are found and the Kurucz, Altrock-Cannon, Mount-Linsky II, and HSRA models are compared. A solar carbon abundance of $\log A_C = 8.30 \pm 0.10$ for the Mount–Linsky model and $\log A_C = 8.40 \pm 0.10$ for the Altrock–Cannon model are derived, compared to the HSRA value of $\log A_C = 8.55 \pm 0.10$, assuming a nitrogen abundance of $\log A_N = 7.93$. In addition the regions of formation for the CN(0,0) 3883.35 Å bandhead at disc center and limb are specified. (auth)

15267 RELATIONSHIP BETWEEN SUDDEN PHASE ANOMALIES AT V. L. F. AND SOLAR X-RAY BURSTS. Kimpara, A. (Chubu Inst. of Tech., Kasugai, Aichi (Japan)). Compt. Rend., Ser. A, B; 280: No. 10, 323-324(10 Mar 1975). (In French).

The relation between sudden phase anomalies observed on North West Cape transmissions (22.3 kHz) and fluxes in three regions of the solar x-ray spectrum during the World Geophysical Interval July 26-August 14, 1972, are studied. (auth)

15268 ABSORPTION FILTERS TO GRAPH THE SUN BY SOFT X-RADIATION. Braeuninger, H. Tuebingen, Ger.; Univ. Tuebingen (1973). 77p. (In German). INIS.

Thesis.

An exact image forming x-ray system is composed of Fresnel zone plates and absorption filters. It could be shown, that using absorption filters an adequate selection, which is necessary to imagine the x-ray sun by Fresnel zone plates, is possible only for wavelengths smaller than 30 A. The image quality is improved relative to earlier measurements by rockets. (BJ)

15269 A SOLAR MODEL WITH LOW NEUTRINO EMISSION. Hoyle, F. (California Institute of Technology). Astrophys. J. Lett. 197: No. 3, L127-L131 (1 May 1975).

A model for the Sun giving a reaction rate on ^{37}Cl as low as 0.5 SNU is discussed. The low neutrino emission comes about because the Sun is taken to have a core containing 0.3–0.5 $M_\odot$ with an unusually high concentration of iron-group metals and a low initial concentration of helium. The high opacity caused by the metals makes the core convective, a suggestion which has been made previously by other authors on an ad hoc basis. In such a situation the low neutrino emission arises for the following two reasons: (1) a high hydrogen concentration, $X \simeq 0.7$, is maintained at the center; (2) convective mixing of ^7Be on a time scale less than the ^7Be destruction time minimizes the importance of $^7Be(p, \gamma)^8B$. (auth)

15270 A NEWLY OBSERVED SOLAR FEATURE: MACROSPICULES IN He II 304 Å. Bohlin, J.D.; Vogel, S.N.; Purcell, J.D.; Sheeley, N.R. Jr.; Tousey, R.; VanHoosier, M.E. (E. O. Hulburt Center for Space Research, U.S. Naval Research Laboratory, Washington DC 20375). Astrophys. J. Lett. 197: No. 3, L133-L135 (1 May 1975).

He II 304 Å spectroheliograms, obtained with NRL extreme-ultraviolet slitless spectrograph during the *Skylab* mission, show spikelike structures at the Sun's polar limb which resemble the familiar Hα spicules. However, the relatively large size and long life of these He II features has led us to distinguish them by the name *macrospicules*. The macrospicules appear as protuberances or jets, ranging from 5″ to over 60″ in length, from 5″ to 30″ in width, and from 5 to over 40 minutes in lifetime. Perhaps the most radical depature from Hα spicules is that macrospicules occur only within the chromospheric boundaries of coronal holes. Thus macrospicules are most easily visible over the solar poles due to the coronal holes normally present there, and much less frequently at lower latitudes during limb passage of relatively rare, low-latitude coronal holes. (auth)

15271 ORIGIN OF BRIGHT UMBRAL DOTS IN SUNSPOTS. Obridko, V.N. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 6, 758-760 (May 1975).

Bright dots are interpreted as the effect of instability in the deep layers of sunspots. (auth)

15272 INTEGRAL EMISSION OF SOLAR FLARES. Slonim, Yu.M.; Korobova, Z.B. (Astronomical Institute, Academy of Sciences of the Uzbek SSR). Sov. Astron.—AJ 18: No. 6, 750-757 (May 1975).

Five white light flares (WLF) are studied on the basis of original observations. It is established that their emission is concentrated in two foci flaring up on both sides of the $H_{\parallel}=0$ line and lying at the base of photospheric and chromospheric loops. The total area of foci is about five millionths of a hemisphere, i.e., ~0.007 of the area of the flare in H α. The brightness of the foci can exceed twice the brightness of the undisturbed photosphere at the center of the disk. The WLF foci are resolved into brighter and finer structural details ~2″ in size. The development of these flares in H α is characterized by the large extension of the line wings and their rapid increase and decrease and by the swift flareup and increased brightness of the nodes at sites of continuous emission. The bearing off of loop systems and ejections from the WLF foci at the time of their flareup possibly indicates the escape of magnetic field lines into the outer layers and their interaction with the existing field there. The estimates obtained indicate that the total energy outputs in the continuum and in H α are comparable to each other. However, the energy flow through a unit surface is two to three orders of magnitude higher in a WLF than in a H α flare. Statistical calculations show that under conditions of a regulated photospheric patrol WLF phenomena should be registered in all rapidly flaring up solar flares. (auth)

15273 SOME CHARACTERISTICS OF THE SLOWLY VARYING COMPONENT OF THE SUN'S RADIO EMISSION FOR A BIPOLAR GROUP. Fasakhova, M.N.; Yudin, O.I. (Gor'kii Scientific Research Radiophysics Institute). Sov. Astron.—AJ 18: No. 6, 765-767 (May 1975).

The characteristics of the S component are calculated for a bipolar group whose magnetic field is approximated by the field of two vertical magnetic dipoles. A spectrum with two maxima ($\lambda = 4$ cm and $\lambda = 21$ cm) was obtained for one of the models of the distribution of electron concentration and kinetic temperature with altitude. This type of spectrum is explained by the existence in the chromosphere of an extended region with a small gradient of electron temperature with altitude. (auth)

15274 RELAXATION OF AN ELECTRON BEAM IN COLLISIONLESS SHOCK WAVES IN THE CORONA. Uralov, A.M. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 18: No. 6, 761-764 (May 1975).

The effects of the quasilinear relation of an electron beam in a plasma whose concentration varies with time are examined. Some applications of these effects in astrophysics are presented. (auth)

15275 ON THE PROPAGATION OF MAGNETIC DISTURBANCES IN THE SOLAR WIND. Lerche, I. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). Astrophys. Space Sci.; 34: No. 2, 309-319(May 1975).

Under the geometrical optics approximation the propagation of a polarized magnetic profile, made up of Alfvén waves, in the solar wind is discussed. It is shown that the profile propagates at an angle to the radial direction (the direction of the solar wind flow), the radial half-width of the profile stays essentially constant, or even diminishes a little, with distance from the Sun, the half-width in a direction transverse to the radial direction increases without limit as the magnetic profile moves outward from the Sun. Thus the profile stretches out into a "ribbon" which could, of course, be experimentally identified as a discontinuity. Equations are also given for the variation of polarization of the profile, and the behavior of polarization in a simple case is illustrated. These calculations have been done to show that the production of "discontinuities" in the solar wind can arise from propagation effects on irregularly shaped "blobs" of magnetic field, as well as from other causes. (auth)

15276 SOLAR MAGNETIC FIELDS AND CONVECTION. I. Active Regions and Sunspots. Piddington, J. H. (National Measurement Lab., Sydney (Australia)). Astrophys. Space Sci.; 34: No. 2, 347-362(May 1975).

A phenomenological model of solar magnetic fields is developed, which differs drastically from all currently popular (diffuse-field) models. Its acceptance would require a review of a major part of theoretical solar physics including convection. Active Regions (ARs), and the nature and effects of surface magnetic fields in general. Magnetic flux concentrations seen in sunspots, in ARs and even in quiet regions are not caused by convective motions but by long-lived (≳1 yr) flux ropes. Upon reaching maturity a flux rope develops an upward loop whose horizontal section emerges through the solar surface during a period of ~3 days, during which period numerous individual flux tubes erupt from the rope to form an Arch Filament System. On emerging, the leading rope end is vertical while the following end is inclined and the two dominate convection in their vicinity. A spot decays because the flux rope unwinds and then may either split into large sections or "fray" by the loss of numerous flux tubes from its outer surface. Fraying slowly extends to depths of $\gtrsim 10^5$ km. The model provides a test for any convection zone model; in particular it is incompatible with the dynamo theory. It is also incompatible with models of convection which attribute the formation of sunspot fields to the supergranulation. (auth)

15277 WHY THE SUN MAY APPEAR OBLATE. Schatten, K. H. (Victoria Univ., Wellington (New Zealand). Dept. of Physics). Astrophys. Space Sci.; 34: No. 2, 467-480(May 1975).

If the Sun loses angular momentum from its core, due to core contraction, into the solar wind at the observed rate, then an ~0.7 day rotational period for the core of the Sun is required for temporal equilibrium. The rotational power released in the core contraction process can equal the observed magnetic energy released in the solar activity cycle if the Sun's core rotates with a period near 1.4 to 4 days. The rotational power released from a rotating object is $\tau\Omega$, where τ is the torque on the object and Ω is its angular velocity. Fitting this to the solar wind torque and core rotation rate provides a 0.5 to 5 day rotation period for the Sun's core. A gravitational Pannekoek-Rosseland electric field in the Sun makes the Ferraro theorem inapplicable in such a way that rather than a constant angular velocity with radius, an inverse square radial dependence occurs. This results in a two day rotational period for the region in the Sun where most of the angular momentum resides. The consistency of the above four methods suggests that the Sun's observed oblateness is due to a rapidly rotating solar core. The oblateness of the photosphere is estimated to be near 3.4×10^{-5}. (auth)

15278 CYCLOTRON WAVES IN THE SOLAR WIND. Horng, J. T. (Radio Physics Group, Telecommunications Laboratories, Chung-Li, Taiwan). Astrophys. Space Sci.; 34: No. 2, L1-L5 (May 1975).

Cyclotron waves in the solar wind near 1 AU with frequencies well below the electron cyclotron frequency and wavelengths much larger than the electron cyclotron radius but less than the proton cyclotron radius are considered. The cyclotron radii are defined from parallel thermal velocity of electron component and proton component with respect to the interplanetary magnetic field. No LH cyclotron waves are found to propagate for $\delta_p < 0$, where $\delta_p \equiv 1 - T_{p\parallel}/T_{p\perp}$ is the temperature anisotropy of the proton component with respect to the interplanetary magnetic field. The damping or growth of RH cyclotron waves is found to depend on the frequency range and the temperature anisotropy of the proton component. The RH cyclotron waves are damped in the frequency range $\omega_r > |\delta_p|\Omega_p$ for $\delta_p < 0$, where Ω_p is the proton cyclotron frequency. RH cyclotron instabilities occur in the frequency range $|\delta_p|\Omega_p > \omega_r > |\delta_p|\Omega_p/(1-\delta_p)$ for $\delta_p < 0$. The marginal state is at $\omega_r = |\delta_p|\Omega_p$. auth)

15279 NI I TRANSITION PROBABILITIES AND THE SOLAR NICKEL ABUNDANCE. Lennard, W.N.; Whaling, W.; Scalo, J.M. (California Institute of Technology); Testerman, L. Astrophys. J. 197: No. 2, 517-526 (15 Apr 1975).

Absolute transition probabilities have been measured for 97 lines from 11 levels in Ni I using the beam-foil lifetime and branching-ratio technique. We have measured equivalent widths at the disk center from the Preliminary Edition of the Kitt Peak Solar Atlas for 49 of the above lines. An empirical solar curve of growth has been constructed to test the consistency of the transition probabilities and equivalent widths. The solar Ni abundance has been computed (1) by matching the equivalent widths of the 10 weakest lines, and (2) by fitting the profiles of 19 lines. Both methods agree within experimental uncertainty and yield an average photospheric Ni abundance of 6.28 ± 0.09. (auth)

15280 A REDUCED UPPER LIMIT TO THE SOLAR BORON ABUNDANCE. Hall, D.N.B. (Kitt Peak National Observatory); Engvöld, O. Astrophys. J. 197: No. 2, 513-515 (15 Apr 1975).

A new upper limit on the solar boron abundance has been obtained from observations of the photospheric spectrum in the 16240 Å region. We find $N_\odot(B)/N_\odot(H) \lesssim 1.2 \pm 0.6 \times 10^{-10}$. The implications of this result for the boron abundance in the primitive solar material are discussed. (auth)

15281 SPECTROSCOPIC DETECTION OF SOLAR ^{3}He. Hall, D.N.B. (Kitt Peak National Observatory). Astrophys. J. 197: No. 2, 509-512 (15 Apr 1975).

Excess emission in the longward wing of the 10830 Å helium feature in a solar prominence is identified as due to solar ^{3}He. A solar ^{3}He/^{4}He abundance ratio of $4 \pm 2 \times 10^{-4}$ is obtained, and its implications are discussed. (auth)

15282 IMPULSIVE SOLAR X—RAY BURSTS. II. STATISTICAL CORRELATION OF OBSERVATIONS WITH SOLAR LONGITUDE. Petrosian, V. (Institute for Plasma Research, Stanford University). Astrophys. J. 197: No. 1, 235-239 (1 Apr 1975).

It is shown that the model where the impulsive solar X-ray bursts result from interaction of a beam of high-energy electrons with solar plasma, agrees both qualitatively and quantitatively with the existing data on variation with solar longitude of frequency distribution and average value of parameters characterizing these bursts. Concerning center-to-limb variations, the model predicts correctly the softening of the impulsive X-ray burst spectra and the absence of variation in other quantities, such as the burst strength, the soft-to-hard X-ray flux ratio, and the frequency of occurrence of bursts. (auth)

15283 SOLAR GRANULATION AND OSCILLATIONS AS SPATIALLY RANDOM PROCESSES. Lynch, D.K. (San Fernando Observatory, The Aerospace Corporation, El Segundo, California); Chapman, G.A. Astrophys. J. 197: No. 1, 241-249 (1 Apr 1975).

Using Sheeley and Bhatnagar's technique to separate the slowly varying and oscillatory component of the photospheric velocity field, we analyze high spatial resolution λ6102.7 velocitygrams (subtracted spectrohelio-grams). A new way of interpreting the power spectra is presented. By invoking simple random models of the velocity field, the shape of the power spectra and autocorrelation functions can be explained quantitatively, and the results show that there are no large cells in either field. The oscillations have a mean size of 6'.9, and the rms velocity amplitude is 0.42 km s^{-1}. For the slowly varying component (granulation at disk center), we find $V_{rms} = 0.24$ km s^{-1}. The effects of seeing are discussed. The interpretation of our results leads to the identification of a restricted region in the k_r-ω diagnostic diagram in which the oscillations fall. (auth)

15284 NONISOTHERMAL MAGNETOSTATIC EQUILIBRIA IN A UNIFORM GRAVITY FIELD. I. MATHEMATICAL FORMULATION. Low, B.C. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. 197: No. 1, 251-255 (1 Apr 1975).

We consider the magnetostatic equilibrium of a two-dimensional plasma in a uniform gravity field. We assume the ideal gas law. By transforming the pressure and temperature into functions of the magnetic vector potential and the vertical height, we show that the vector equation of equilibrium in the cases of Cartesian and cylindrical coordinate systems reduces to a single scalar nonlinear elliptic partial differential equation. This mathematical simplification has hitherto been afforded only with the additional assumption of uniform temperature, whereas in the mathematical formulation presented here the temperature is an arbitrary function of space. A discussion is given on the general properties of the equations derived and their physical implications. In particular, we point out that photospheric conditions at any one time in general do not determine unique magnetostatic equilibrium configurations above the photosphere. Applications of the equations derived here to different solar situations of interest will be taken up in the following papers of this series. (auth)

15285 EVOLUTION OF THE SOLAR INNER ROTATION. Sakurai, T. (Kyoto Univ.). Mon. Not. R. Astron. Soc.; 171: No. 1, 35-52(Apr 1975).

The evolution of the axisymmetric rotation of the radiative interior of the Sun is studied based on the Eddington–Sweet theory of perturbation. The effect of the molecular weight gradient is neglected, but the effects of the eddy viscosity and of the solar wind torque are taken into account. A new formulation of the initial boundary value problem of a system of the potential equation and the higher order non-linear diffusion equation is given and a reasonably stable method of solution is proposed. By this formulation it is possible to resolve the difficulty of the Eddington–Sweet theory, in which the meridional velocity becomes indefinitely large on the interface between the radiative and the convective regions. The evolution of the solar inner rotation has been calculated for several values of the eddy viscosity, but it is not yet possible to say what is the correct value for the eddy viscosity. (auth)

15286 IDENTIFICATION OF SOLAR FLARE FE VXIII TO FE XXIII EMISSION LINES FROM $2s^n2p^k$-$2s^{n-1}2p^{k+1}$ TRANSITIO Fawcett, B. C. (Univ. of California, Los Angeles); Cowan, R. D. Mon. Not. R. Astron. Soc.; 171: No. 1, 1-7(Apr 1975).

Solar flare emission lines due to $2s^n2p^k$-$2s^{n-1}2p^{k+1}$ transitions of Fe XVIII to Fe XXIII are identified in the spectral region between 66 and 140 Å. The published solar flare spectra from the Goddard Space Flight Center experiment on OSO 5 were used for this analysis. Line classifications are based on data acquired from recent laboratory observations and theoretical extrapolations from these data. Previous identifications are revised and observations which may allow the measurement of solar flare densities are discussed. (auth)

15287 SEARCH FOR THE TIME EVOLUTIVE CHARACTERISTICS OF THE SPECTRUM OF IMPULSIVE SOLAR BURSTS. Matsuura, O. T. (Universidade Mackenzie, Sao Paulo, Brazil). Rev. Bras. Fis.; 3: 487-514(Dec 1973).

By considering alternative explanations in order to account for the time evolutive features of the spectrum of impulsive bursts, a suitable model for these events and accompanying phenomena is presented. Established on the grounds of a few cases, the model looks suitable for all the impulsive class, bringing information on plasma phenomena like Razin effect, polarization reversal, acceleration of particles by shock, relaxation times, three dimensional flare expansion and radiative instability. It also looks suitable for explaining the spectral cutoffs, the rise- and fall-time of burst spectra, associated magnetic fields, and other spectral characteristics. (Int. Aerosp. Abstr.) (auth)

15288 INTERPRETATION OF THE FORBIDDEN EMISSION LINES FROM A CORONAL CONDENSATION. Mason, H. E. (University Coll., London). Mon. Not. R. Astron. Soc.; 171: No. 1, 119-130(Apr 1975).

Theoretical emission rates have recently been computed (Mason) for six lines observed in the visible spectrum of the solar corona. These rates are used to analyse the spectra of a coronal condensation observed by Lyot and Aly at the 1952 eclipse (Aly et al.). Average electron density and temperature conditions for the condensation are deduced and a specific model is proposed, in which electron density and temperature estimates are defined as a function of position within the condensation. Since continuum measurements were also recorded, abundance estimates for iron and calcium relative to hydrogen are obtained. The structure of the model is seen to be consistent with other solar observation. (auth)

15289 TABLE OF SOLAR DIATOMIC MOLECULAR LINES. I. Spectral Range: 6100 to 6600 A. Boyer, R. (Observatoire, Meudon, France); Sotirovski, P.; Harvey, J. W. Astron. Astrophys., Suppl. Ser.; 19: No. 3, 359-387(Mar 1975).

A table of molecular lines observed in the spectrum of a sunspot in the wavelength range 6100–8300 Å is in preparation. The present publication of results between 6100 and 6600 Å represents the first part of this work. An introductory text gives a detailed description of each column of the table. For each identified line the rotation branch, quantum number and the vibration band are indicated. The equivalent widths for all lines with profiles were measured as free from blending as possible, the effect of scattering from the photosphere and the edges of strong Fraunhofer lines being taken into account. (auth)

Galaxies

Refer also to abstracts 15086, 15105, 15144, 15164, 15177, 15211, 15220, 15221, 15238, and 15366.

15290 (HMI-B-162) FOURIER ANALYSIS OF STEADY-STATE REACTION SCHEMES FOR INTERSTELLAR MOLECULES. Kuntz, P. J. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). 1975. 22p. Dep. NTIS (US Sales Only) $4.25.

A Fourier analysis technique is applied to a steady-state scheme of reactions meant to describe the formation of H_2 in the interstellar medium in order to assess the sensitivity of the H_2 concentrations to uncertainties in the rate coefficients used in the scheme. (auth)

15291 COMPTON SCATTERING ON THE DIFFUSE UV AND X-RAY BACKGROUND. A Reappraisal. Gavallo, G. (CNR, Bologna); Ventura, A. Lett. Nuovo Cim.; 12: No. 5, 143-146 (1 Feb 1975).

Scattering of electrons on the low-energy X-ray spectrum may give a high enough flux in some energy range as to deform in a substantial way the previous shape. Low-energy (< 0.3 keV) X-rays need not be produced by the first inverse Compton scattering. An examination of experimental data leads to the approximation of the intergalactic electron flux with a sharp power-law break. Some conclusions about the galactic or extragalactic origin of the X-ray flux and about the clumpiness of the interstellar medium might be inferred from further study of scattered soft X-ray photons. (BJG)

15292 GALAXIES AND RELATIVISTIC ASTROPHYSICS. Proceedings of the First European Astronomical Meeting, Athens, Greece, September 4-9, 1972. Volume 3. Barbanis, B.; Hadjidemetriou, J. D. (eds.). Berlin; Springer-Verlag (1974). 256p. (CONF-7209122-P3). $51.50.

The 31 papers presented include 19 on the observational and theoretical aspects of the composition and dynamics galaxies and 12 on neutron stars, black holes, x-ray and radio sources and other topics in relativistic and high energy astrophysics. (BJG)

15293 MYSTERIOUS EGG NEBULA IN CYGNUS. Ney, E. P. (Univ. of Minnesota, Minneapolis). Sky Telesc.; 49: No. 1, 21-23 (Jan 1975).

A sketch is given of how knowledge of the Egg nebula in Cygnus rapidly accumulated. Included are a number of photographs and a list of events concerning this nebula. (JFP)

15294 HOT HYDROGEN IN PREBIOLOGICAL AND INTERSTELLAR CHEMISTRY. Sagan, C. (Cornell Univ., Ithaca, NY). Science; 188: No. 4183, 72-73(4 Apr 1975).

Similarities and differences of two experiments (Hong et al., Science, 184-984(1974) and Sagan et al., ibid, 173,417(1971)) are discussed with emphasis on hot hydrogen atom production mechanisms and the relevance of the experiments to prebiological organic synthesis and interstellar organic chemistry (CES)

15295 METAL ABUNDANCES OF RR LYRAE STARS IN GALACTIC GLOBULAR CLUSTERS. Butler, D. S. Santa Cruz, CA; Univ. of California (1974). 100p. University Microfilms Order No. 75-8473.

Thesis (Ph. D.).

Image-tube scanner measurements of Preston's (1959) metal abundance indicator have been made for 47 RR Lyraes. Another index that is a measure of metallic-line absorption in the region of the G-band has also been determined. From curve-of-growth analyses of 13 field RR Lyraes, the relationship [Fe/H] equals -0.16 DELTA S(K)–0.23 is found, where [Fe/H] equals log (Fe/H)$_*$ – log (Fe/H)$_\odot$. The problem of the anomalous horizontal-branch distribution functions in M13 and NGC 7006 is discussed in the light of these new observations. It is suggested that differences in the location of the horizontal branch in clusters with the same [Fe/H] result from different degrees of mixing between the envelope and the hydrogen-burning shell in the horizontal branch progenitor. (auth)

15296 INTERPRETATION OF FARADAY ROTATION IN THE GALACTIC MAGNETIC FIELD. Nissen, D.; Thielheim, K. O. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Astrophys. Space Sci.; 33: No. 2, 441-451(Apr 1975).

The autocorrelation function of Faraday rotation measures is discussed in terms of different types of galactic field configurations. The autocorrelation function evaluated from published data of 139 radio galaxies and quasars is found to resemble a form typical for a quasi-longitudinal field, whereas the autocorrelation function of 38 pulsars turns out to be of the form expected for a longitudinal field. These observations are interpreted with respect to the position of the solar system relative to the neutral sheet in a quasi-longitudinal field configuration. Rotation measures calculated theoretically using a mathematical formulation of the quasi-longitudinal field model are adapted to experimental data. The resulting "polarity" of the global field structure is discussed in connection with the original dipole-like configuration the magnetic momentum vector of which is

found to have been antiparallel to the angular momentum vector of the Galaxy. The relation between the field strength and the density of electrons is found to be consistent with earlier results. (auth)

15297 CHEMICAL EVOLUTION OF THE GALAXY DURING ITS CONTRACTION. Kaufman, M. (Strasbourg-1 Univ., 67 (France)). Astrophys. Space Sci.; 33: No. 2, 265-295(Apr 1975).

Models for the chemical evolution of the Galaxy are constructed in which the time evolution is imposed by the contraction rate of the Galaxy and present observations of stellar metal abundances as a function of height above the galactic plane. Stars with mass $m \lesssim 3.5\ M_\odot$ do not contribute to the metal enrichment of the interstellar gas, and it is argued that the interstellar metal abundance at this epoch should be fairly insensitive to the size of the mass fraction of the Galaxy that condenses into such stars. The birth rate for stars more massive than $3.5\ M_\odot$ is assumed proportional to V_{gal}^{-1}, where V_{gal} is the contracting volume of the main body of the Galaxy. If a dynamic time-scale is adopted for the contraction of the Galaxy, then the assumed power-law birth rate yields suitable chemical evolution models only if observed Population II metals are synthesized in stars more massive than about $8.5M_\odot$. This mass range is consistent with the predictions of current stellar-evolution theory. (auth)

15298 ELECTROMAGNETIC INSTABILITY IN COLLISIONLESS ANISOTROPIC PLASMA CONTRASTREAMS. Aggarwal, S. S. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Astrophys. Space Sci.; 33: No. 2, 259-264(Apr 1975).

The electromagnetic instability in collisionless, anisotropic magnetized plasma contrastreams for perturbations propagating normally to the ambient magnetic field is investigated. It is found that the parallel temperature stabilizes the configuration for $T_\parallel \leq T_\perp$ while it shows destabilizing effect for $T_\parallel \geq T_\perp$. A comparative study of the growth rates associated with various coexisting modes reveals that the electromagnetic instability may, under certain conditions, be associated with larger growth rates than the electrostatic instability. (auth)

15299 PLASMA TURBULENT REACTORS: AN ASTROPHYSICAL PARADIGM. Norman, C. A.; ter Haar, D. (Oxford Univ. (UK). Dept. of Theoretical Physics).

62 refs.

A model system is developed to describe some of the effects of a turbulent astrophysical plasma, in particular, its interaction with relativistic electrons and their radiation. This system is called a plasma turbulent reactor (PTR). The theory of an infinite PTR is considered and in such a PTR it is shown that the relativistic electrons will have a power-law energy distribution. The analogy between this power-law distribution and the Kolmogorov spectrum in hydrodynamic turbulence is discussed. The parameter constraints on PTR theory and the applicability of the theory to astrophysical systems, such as galactic nuclei, pulsars, collapsing protostars, and solar flares are then discussed. (auth)

15300 THE INFLUENCE OF GRAIN MANTLES ON THE FORMATION OF HYDROGEN MOLECULES ON GRAIN SURFACES. Lee, T. J. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 34: No. 1, 123-130(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

The physical adsorption energy, E, of hydrogen molecules on various substrates at temperatures between 5 and 30 K and at the lowest practicable gas densities has been measured. Values of E/k are for condensed CO 340 K, CO_2 800 K, H_2O 850 K, and for "dirty" graphite 980 K and "dirty" copper 800 K. From these measurements temperature ranges in which H atoms might combine on the surface to form H_2 molecules are estimated. Duley has discussed the formation and composition of condensed gas mantles on interstellar grains. The effects of such mantles in promoting and poisoning hydrogen molecule formation are discussed. (auth)

15301 LARGE-SCALE IONIZATION FRONTS AND THE NATURE AND DISTRIBUTION OF LIGHT SCATTERING PARTICLES IN THE ORION NEBULA. Dopita, M. A.; Meaburn, J. (Manchester Univ. (UK)); Isobe, S. (Astronomisches Rechen-Institut, Heidelberg, Germany). Astrophys. Space Sci.; 34: No. 1, 91-121(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Image-tube filter photographs calibrated against photoelectric filter photometry have been used to give maps of M42 in absolute flux units over the central 15 arc min of the nebula in Hα, [N II] (λ 6584 Å), Hβ, and continuum at λ 4700 Å. Maps of the ratios Hα/[N II] and (for the first time) of continuum/Hβ have been produced with unprecedented spatial resolution. These show that the gas to dust ratio is high near the exciting stars and falls strongly in the vicinity of large scale ionization fronts marked by minima in the Hα/[N II] ratio. These results are interpreted in terms of detailed shell models containing either ice or graphite or silicate scattering particles. In all models there must be a central hole in the distribution of scattering particles. The effect of neutral globules and intrusions is investigated. It is found that all types of grain are trapped inside neutral intrusions near the centre of the nebula by the pressure of the Lα light surrounding the globule, but in the early evolution of the nebula particles can escape into the ionized medium when fronts are R-type. Ice grains escaping at this time will be destroyed for distances to the exciting stars less than 1 pc. These results can explain both the central hole in dust and the underabundance of oxygen in the ionized gas observed earlier. Arguments depending on colour index of the scattered light indicate that mixtures of scattered light from ice in the globules and from ice in the ionized medium can explain the observations, but that the graphite and silicate particles fail. A schematic model of the Orion Nebula is presented to attempt to explain the large-scale phenomena observed here. It demonstrates that simple shell models for this nebula are dubious. (auth)

15302 EFFECTS OF CHARGED DUST GRAINS. Hayakawa, S. (Nagoya Univ. (Japan). Dept. of Physics). Astrophys. Space Sci.; 34: No. 1, 73-79(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Dust grains expelled by radiation pressure of stars are charged to potentials in the range 30 to 40 V in H I clouds. These grains may be responsible for the following phenomena which are otherwise hardly explicable. (1) A considerable fraction of electrons knocked-out by charged grains of high speeds have energies around 15 eV and produce singly ionized ions but not doubly ionized ones in accord with an ultraviolet observation of interstellar atoms and ions. (2) Transverse momentum transferred to grains by Coulomb scattering of ambient electrons and protons is greater than that by multiple scattering of cosmic-ray protons, thus the former being more effective for the grain alignment than the latter. (3) At a shock front charge separation due to a large inertial mass of grains produces an electric field, thus accelerating charged particles and causing a drift of interstellar matter. (auth)

15303 PHYSICAL ADSORPTION OF HYDROGEN ON INTERSTELLAR GRAPHITE GRAIN SURFACES. Willis, R. F.; Fitton, B. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Astrophys. Space Sci.; 34: No. 1, 57-71 (Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974). 37 refs.

Existing single-particle theories concerning parameters of importance which determine the kinetics of hydrogen molecule formation and ejection from cold ($T_{gr} \lesssim 20$ K) graphite grain surfaces are reviewed. The nature of the single-particle quantum states of low-mass gas atoms and molecules in a periodic surface lattice potential is considered. Contributions to the physical adsorption potential due to dynamic polarizability effects arising from the long-range collective valence-electron charge-density oscillations (plasmons) of the substrate are discussed. Short-range electron correlation effects at the surface may lead to the formation of a "quasimolecular state" of adsorbed H_2 with a bond length ~3.5 Å and a reduced bond energy ~0.075 eV. It is proposed, that one consequence of this dynamical screening of the adsorbed molecules is that they are ejected normal to the grain surface with velocities $\lesssim 20$ km s^{-1} and not necessarily in a high vibrational state. Similar dynamical effects could be important in determining activation processes and long-range ordering in monolayer films of adsorbed H_2. The astrophysical consequences of these many-body effects are discussed in the light of recent experimental and observational results. (auth)

15304 A REVIEW OF RECENT OBSERVATIONS OF DUST IN H II REGIONS. Smith, L. F. (Max-Planck-Institut fuer Radioastronomie, Bonn (F. R. Germany)). Astrophys. Space Sci.; 34: No. 1, 49-55(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974). 27 refs.

The upper limit for the absorption cross section σ_H^{abs}, of dust in H II regions in the wavelength range 912 to 504 Å derived by Mezger et al. (1974), is compatible with that expected for large dust grains, and a gas-to-dust ratio equal to that in the general interstellar medium. The albedo of the small grains must be high for $\lambda > 504$ Å. This restriction is lifted if the visual extinction cross section of the grains in H II regions is less than that for grains in the general interstellar medium. New observations of the Orion Nebula indicate that the visual extinction cross

section is within a factor 2 of the value in the general interstellar medium. (auth)

15305 INTERSTELLAR EXTINCTION AND DIFFUSE ABSORPTION FEATURES. Dorschner, J. (Friedrich–Schiller-Universitaet, Jena (German Democratic Republic). Universitaets–Sternwarte). Astrophys. Space Sci.; 34: No. 1, 39-47(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

The equivalent width of the λ2175 Å band, W_{2175}, well known as the big bump in the interstellar extinction curves, has been found to be closely correlated with the colour excess E_{B-V} as well as with the extinction differences E_{8-6} and E_{9-7} defined to characterize quantitatively the steep slopes of the extinction curves in the far ultraviolet. The equivalent widths of the λλ 5780 and 5797 Å diffuse lines show good correlation with E_{B-V}. The correlations of W_{5780} and W_{5797} with E_{8-6} resp. E_{9-7} are, however, rather weak. Correlations between W_{2175} and W_{5780} and between W_{2175} and W_{5797} are indicated. The results have been qualitatively interpreted in favour of the dust model consisting of a mixture of small silicate grains and larger silicate grains coated by molecular mantles. (auth)

15306 DIFFUSE INTERSTELLAR BAND FORMATION IN DENSE CLOUDS. Snow, T. P. Jr. (Princeton Univ., N. J. (USA). Observatory); Cohen, J. G. (Kitt Peak National Observatory, Tucson, Ariz. (USA)). Astrophys. Space Sci.; 34: No. 1, 33-38(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Measurements of the strengths of the diffuse interstellar bands at 4430, 5780, and 5797 Å show that the bands tend to be weak with respect to extinction in dense interstellar clouds. Data on 10 stars in the Ophiuchi cloud complex show further that the diffuse band-producing efficiency of the grains decreases systematically with increasing grain size. It is concluded that the diffuse bands are not formed in the mantles which accrete on the grains in interstellar clouds, but that they could be produced in the cores of grains or in some molecular species. (auth)

15307 FAR-ULTRAVIOLET EXTINCTION IN SIGMA SCORPII. Snow, T. P. Jr.; York, D. G. (Princeton Univ., N. J. (USA). Observatory). Astrophys. Space Sci.; 34: No. 1, 19-22(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

It was found earlier from OAO-2 data (Bless and Savage, 1972) that considerable variability with direction in space is present in both the shape and level (relative to B−V color excess) of the interstellar extinction curve in the far ultraviolet. The star σ Sco was shown to be a case of extremely low uv extinction, but there was some question of whether this could be due to scattered nebular light entering the large entrance slit of the Wisconsin spectrometer aboard OAO-2. uv data on σ Sco has been obtained using Copernicus (OAO-3), which has an entrance slit on the order of 10^3 times smaller in projected area than that of OAO-2, so that the contribution to the signal from scattered nebular light would be correspondingly smaller. Very good agreement with the extinction curve of Bless and Savage is found, confirming the low uv extinction in the line of sight to σ Sco. The curve is extended down to 1000 Å, showing a continued rise towards short wavelengths. (auth)

15308 FEATURES OF THE INTERSTELLAR EXTINCTION CURVE. Morgan, D. H. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 34: No. 1, 11-17(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

The extinction curves for spherical particles are subject to the errors of the particle material's refractive index. Their sensitivity to these errors has been investigated and is found to be dependent upon wavelength. For graphite, significant errors are produced in the far ultraviolet part of the extinction curve; for silicates, in the near ultraviolet; while for iron the error is relatively small. The wavelength dependence of the 10 μm and 20 μm absorption bands of small silicate spheroids upon their shape and alignment has been studied. It is found that the bands can be displaced by ~1 μm towards longer wavelengths from their positions for corresponding spheres: and that a further, though small, displacement can be superimposed upon this by their subsequent alignment. (auth)

15309 ON THE RATIO OF THE TOTAL TO SELECTIVE ABSORPTION. Sherwood, W. A. (Bochum Univ. (F. R. Germany). Astronomisches Inst.). Astrophys. Space Sci.; 34: No. 1, 3-10 (Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

The ratio of total to selective absorption, R, has been found to remain constant as dust is processed in clouds from low to high density, through H II regions and open clusters, and returned to the interstellar medium. R has the same value in dense dust clouds as it has in H II regions of different ages. Variations in R values obtained from stars in H II regions may be due to errors in special type classification. Globular cluster diameters show no tendency to increase with distance from the Sun when R = 3.2 is used. Large grains evidently do not exist in the interstellar medium. There is no evidence for neutral extinction in the Galaxy at large. (auth)

15310 CONSIDERATIONS ABOUT THE ABSORPTION EFFICIENCY OF DUST PARTICLES IN THE INFRARED. Bussoletti, E.; Borghesi, A.; Leggieri, G.; Blanco, A. (Lecce Univ. (Italy). Istituto de Fisica). Astrophys. Space Sci.; 34: No. 1, 191-197 (Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Analytical approximations used often in the literature for calculating energy rates emitted by dust grains in infrared are discussed. Comparisons with correct complete formulations are made for three grain models: (1) pure graphite, (2) ice mantle-graphite core, (3) silicates. λ^{-1} and λ^{-2} dependences for the average effective emissivity of such grains are used. It is found that for silicate and graphite grains the simplified approximations are valid only when accuracies between 10% and 50% are required and only for grain temperatures higher than 80 K. At lower temperatures the validity of the approximations fails for the graphite particle while it is variable for the silicate dust grain. The ice core mantle particles can instead be treated with approximated formulae without introducing appreciable errors. (auth)

15311 THE PLAUSIBILITY OF SILICATE-CORE ICE-MANTLE GRAINS. Dempsey, M. J.; Wickramasinghe, N. C. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 34: No. 1, 185-189(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Extinction curves for silicate-core ice-mantle grains are computed and compared with the infrared spectral data on the BN object in the Orion Nebula. A ratio of outer mantle to core radius of 1.3 which best fits this data suggests that silicate-core ice-mantle grains are unlikely to contribute a major part to the total visual extinction coefficient of interstellar material. (auth)

15312 OPTICAL PROPERTIES OF PARTICULATES. Huffman, D. R. (Arizona Univ., Tucson (USA). Dept. of Physics). Astrophys. Space Sci.; 34: No. 1, 175-184(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Optical properties of small particles of olivine (less than 0.1μ) have been studied in the ultraviolet as an example of an insulating solid. Very little structure survives in the ultraviolet extinction curves for such small particles. By contrast "surface modes", observed for graphite small particles in the ultraviolet and for olivine particles in the infrared, produce dominant and persistent structure in extinction. The general trend of optical properties of graphite is surprisingly similar to the behavior required to explain all features of the interstellar extinction and albedo curves from near visible to 1000 Å. Measured extinction of small olivine particles in the infrared agrees with calculations based on newly measured optical constants, but dominant sharp structure in the 10 μ region still presents a bit of a problem in explaining "silicate" features in astronomical data. (auth)

15313 UV RADIATION FIELDS IN DARK CLOUDS. Whitworth, A. P. (Sterrewacht, Leiden, The Netherlands). Astrophys. Space Sci.; 34: No. 1, 155-173(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

How dark is it inside a dark cloud? If—as is currently believed—interstellar extinction at uv wavelengths is mainly due to scattering with a strongly forward throwing phase-function, the interior of a dark cloud may be much better illuminated at uv wavelengths than its measured extinction would suggest. The author considers the penetration of radiation into a dark cloud against scattering and absorption by grains and defines a new group property for interstellar grains; the exclusion optical depth $\tau_d.\tau_d$ is a measure of the ability of the grains to exclude radiation from the interior of an externally illuminated cloud. Radiation—as measured by the radiation energy density—penetrates the cloud approximately as if against pure absorption only, with effective optical depth τ_d. Thus τ_d is a conceptually and numerically useful quantity when estimating the role of uv radia-

tion in the thermal and chemical balance within a dark cloud. Computations are made of the radiation fields in (1200, 4500) Å, at the centres of dark clouds with measured visual extinctions. It is found that even in very dark clouds, the radiation energy density in (1200, 1800) Å may be significant, due to the high grain albedo at these short wavelengths. (auth)

15314 GRAIN CHARGING IN H II REGIONS. Moorwood, A. F. M.; Feuerbacher, B. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Astrophys. Space Sci.; 34: No. 1, 137-147(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U. K. (9 Jul 1974).

Equilibrium grain potentials have been calculated as a function of radial position and for a wide range of electron densities in H II regions ionized by stars of spectral type O5 and BO. Results are presented for both graphite (low yield photoemitter) and aluminium oxide (high yield photoemitter) for which laboratory photoemission data has been obtained. The results for aluminum oxide should approximate the behavior expected of dielectric grains—e.g., silicates which may be present in H II regions. The importance of charging is discussed in relation to the growth and motion of grains in these regions. (auth)

15315 INTENSITY PROFILES AND COLOR DISTRIBUTIONS IN THE NON-NUCLEAR REGIONS OF Sb GALAXIES. Simkin, S.M. (Department of Astronomy and Astrophysics, Michigan State University, East Lansing, Michigan 48824). Astron. J. 80: No. 6, 415-426 (June 1975).

Intensity profiles, isophotes, and color distributions for a sample of four nearby Sb galaxies indicate: (1) The "exponential disk" in this type of object is uniform in color out to a radius of ~ 15 kpc, where it appears to either change abruptly or merge into the halo. (2) The color indices and outer isophotes of the regions beyond this "merger point" are consistent with a metal-poor "halo" population enriched with BHB stars and possibly some M dwarfs. (3) Observed "red excesses" in the outer regions of one of these spiral galaxies may conceivably be explained by tidal interaction with nearby galaxies. (auth)

15316 DO COMETS PLAY A ROLE IN GALACTIC CHEMISTRY AND γ-RAY BURSTS? Whipple, F.L. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138). Astron. J. 80: No. 7, 525-531 (July 1975).

This paper explores the plausibility of the assumption that enough material from interstellar space is locked up in comets to reduce significantly the apparent growth rate of "heavy" elements (mass greater than He) and, therefore, the present abundance of heavy elements in the interstellar medium and in the disk stars. A related suggestion concerns the influx of comets on neutron stars as a source of γ-ray bursts. Although no interstellar comets have been observed, reasonable upper limits to the observed numbers and masses do not rule out the first suggestion. The γ-ray-burst suggestion appears unlikely. A surprisingly large total mass of comets could be gravitationally bound to the Sun and, of course, to other stars, but remain undetected. The nature of the 1908 Tunguska explosion is discussed briefly. It was probably not an encounter with an active comet. (auth)

15317 PHOTOELECTRIC PHOTOMETRY AND CALIBRATED ISOPHOTOMETRY OF NGC 520. Krienke, O.K. Jr. (University of Washington, Seattle, Washington 98195). Astron. J. 80: No. 7, 492-497 (July 1975).

BVr photoelectric observations were made of an 18 spot rectangular grid fitted to the Irr II galaxy, NGC 520, and photographic isophotes were constructed. An isophote calibration procedure is demonstrated for the utilization of photoelectric spots of diameter several times of scale of resolved structure. Luminosity profiles for portions of NGC 520 show the presence of an exponential disc and a spheroidal component. A comparison of models for NGC 520 favors the conclusion that NGC 520 is best understood as a close pair of tidally interacting galaxies. (auth)

15318 R—ASSOCIATIONS III. LOCAL OPTICAL SPIRAL STRUCTURE. Herbst, W. (David Dunlap Observatory, Richmond Hill, Ontario, Canada). Astron. J. 80: No. 7, 503-509 (July 1975).

The galactic distribution of R-associations is investigated. They show that the local (Cygnus) spiral feature extends over 2 kpc in the direction of Vela ($l \sim 265°$), and is clearly separated from the next inner (Carina–Sagittarius) spiral feature. There is some evidence for a concentration of the dust towards the inner edge of the local optical spiral feature, a phenomenon which is observed in external galaxies (Lynds 1970, 1972). The R-associations are combined with other good spiral tracers to produce a new map of optical spiral structure. A possible interpretation of this map is suggested in which the angle of inclination of the spiral arms is $13° \pm 4°$. (auth)

15319 NEON III IN PLANETARY NEBULAE. Ahern, F.J. (David Dunlap Observatory, Richmond Hill, Ontario). Astrophys. J. 197: No. 3, 635-637 (1 May 1975).

We show that there is remarkably little variation in the Ne III/O III abundance ratio among the bright planetary nebulae. This makes it reasonable to use the intensity ratio of the nebular transitions Ne III λ3869/O III λ5007 to aid in estimating the electron density and temperature where suitable auroral to nebular intensity ratios are not available. (auth)

15320 ABSORPTION-LINE REDSHIFTS OF GALAXIES IN REMOTE CLUSTERS OBTAINED WITH A SKY–SUBTRACTION SPECTROGRAPH USING AN SIT TELEVISION DECTECTOR. Westphal, J.A.; Kristian, J.; Sandage, A. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. Lett. 197: No. 3, L95-L98 (1 May 1975).

A prism spectrograph with an associated SIT television camera, operating as a two-dimensional detector with digital readout, has been used at the 5-m Hale telescope. The system was tested for its ability to subtract the sky spectrum, and was found to produce difference spectra that are essentially photon noise limited. Redshifts of 14 galaxies in clusters with $0.01 \leqslant z \leqslant 0.4$ were obtained, each with exposure times of 90 minutes or less. Nine of the redshifts are new. Redshifts for the remaining five agree with previous values to within the measuring errors. The speed and sky-subtraction capabilities of the instrument are sufficient to begin routine measurement of absorption-line redshifts for remote cluster galaxies in an effort to extend the Hubble diagram. (auth)

15321 THE ENERGY SPECTRUM OF THE PERSEUS CLUSTER OF GALAXIES. Wolff, R.S.; Helava, H.; Weisskopf, M.C. (Columbia Astrophysics Laboratory, Columbia University). Astrophys. J. Lett. 197: No. 3, L99-L103 (1 May 1975).

A one-dimensional focusing X-ray telescope has been used to measure the spatial structure and energy spectrum of the Perseus cluster in the 0.5–4.5 keV X-ray range. We observe a significant variation in the X-ray spectrum from different regions of the cluster, indicating different possible emission mechanisms. The spectrum from the region centered on NGC 1275 appears harder and more off at low energy than that of the remainder of the cluster. (auth)

15322 BINARY GALAXY ORBIT STATISTICS. I. FIXED MASS AND MAJOR AXIS. Noerdlinger, P.D. (Department of Astronomy and Astrophysics, Michigan State University). Astrophys. J. 197: No. 3, 545-550 (1 May 1975).

Averages for the projected separation ρ, squared radial velocity difference $\dot{z}^2$, and the product of these $\rho\dot{z}^2$, are presented for a binary galaxy system of fixed mass and major axis, but any orbital eccentricity ϵ. The average of $\rho\dot{z}^2$ varies by a factor ~3 in the range $0 < \epsilon < 1.0$. For circular orbits, the results agree with those of Page, but for linear orbits his mass estimate is too small by a factor 6. The mutual regressions of the velocity and separation on each other are calculated, and are presented in such a way as to exhibit the relative likelihood of occupation of the different parts of the regression curves. "Isopleths" for the probability distribution in $(\rho,\dot{z})$—space are presented for a few values of the eccentricity to illustrate the underlying cause of pileup at certain parts of the regression curves. It is concluded that previous analyses were inadequate for failing to take into account that the regression curves represent in many cases a distribution that is almost wholly depopulated through most of the range. In a subsequent paper, a distribution of semimajor axes, masses and eccentricities will be considered, but it is evident that the data are insufficient to draw a firm conclusion about the distribution of eccentricities. (auth)

15323 THE EVOLUTION OF GALAXIES. IV. HIGHLY FLATTENED DISKS. Talbot, R.J. Jr. (Department of Space Physics and Astronomy, Rice University); Arnett, W.D. Astrophys. J. 197: No. 3, 551-570 (1 May 1975).

We present computations of the structure and evolution of models of the disk component of galaxies. The models display the qualitative characteristics and the statistically dominant trends observed in late-type spirals. The radial distributions of neutral hydrogen, of H II regions, and of colors are well reproduced. We find composition gradient across the faces of disk models. Using the observed supernova rates in spiral, these models place fairly severe constraints upon the progenitors of supernova. If azimuthally averaged, high-resolution observations of neutral hydrogen will provide interesting quantitative tests of models of this type. Equations governing the structure and evolution of our models of the disk components are discussed in detail, as are the uncertainties in input physics and astronomy. (auth)

15324 SIX-CENTIMETER H_2CO EMISSION FROM THE ORION NEBULA. Zuckerman, B. (University of California, Berkeley); Palmer, P.; Rickard, L.J. Astrophys. J. 197: No. 3, 571-573 (1 May 1975).

With the Max Planck Institute's 100-m antenna at Effelsberg, the $1_{11}-1_{10}$ transition of H_2CO has been detected in emission in the Orion molecular cloud. Thus, the otherwise ubiquitous cooling of this 6-cm transition is quenched at the H_2 densities $\sim 10^3$ cm^{-3} deduced to exist in the central regions of this cloud. (auth)

15325 INTERSTELLAR CLOUDS CONTAINING OPTICALLY THIN H_2. Jura, M. (Princeton University Observatory). Astrophys. J. 197: No. 3, 575-580 (1 May 1975).

We consider clouds which contain H_2 that is optically thin in the Lyman and Werner bands; and following Black and Dalgarno and Spitzer and Zweibel, we develop models to explain the observed populations in the excited rotational levels. Observational uncertainties preclude arriving at very precise conclusions, but to achieve good agreement with the measurements we argue that a considerable fraction of all the H_2 formed on grains is created with some degree of rotational excitation, and that the formation rate on grains, R, is such that $10^{-17} \leqslant R \leqslant 3 \times 10^{-17}$ cm^3 s^{-1}, but our results are not sufficiently accurate to determine if R does vary. Also, we infer densities within different clouds, and we find that in general n (H) ranges between 10 and 100 cm^{-3}, except that toward ζ Ori there exists a cloud with n (H) = 1000 cm^{-3}. We infer the radiation field within clouds and whether the cloud is near an early-type star. For example, the neutral hydrogen observed toward τ Sco is probably at the outer boundary of the H —— region surrounding that star. (auth)

15326 INTERSTELLAR CLOUDS CONTAINING OPTICALLY THICK H_2. Jura, M. (Princeton University Observatory). Astrophys. J. 197: No. 3, 581-586 (1 May 1975).

We consider those interstellar clouds in which the H_2 is observed to be optically thick in the Lyman bands, and we employ the techniques developed by Black and Dalgarno to infer physical conditions within these clouds by examining the relative populations of the different H_2 rotational levels. We find that if H_2 is formed on grains with rate R, and if n is the total density of hydrogen nuclei, then the product of these two quantities can be determined quite simply from the observations. We find that Rn ranges between 5×10^{-16} and 3×10^{-14} s^{-1}, and if $R = 3 \times 10^{-17}$ cm^3 s^{-1}, as seems reasonable from our previous work, then n varies between 15 and 900 cm^{-3}. We can also estimate the radiation field in each cloud from the populations of the H_2 rotational levels. Of the 10 clouds studied, five are illuminated by an ultraviolet field appropriate to within a factor of 2 to that in the solar neighborhood, four appear to be near the stars against which they are observed, and one is irradiated by a very low intensity field. Our results also suggest that there are substantial pressure variations in the interstellar gas, even among those clouds not near H II regions. (auth)

15327 CLOUD STRUCTURE AND PHYSICAL VARIABILITY IN THE GASEOUS ENVELOPE OF THE NUCLEUS OF THE SEYFERT GALAXY NGC 1275. Pronik, I.I. (Crimean Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 6, 717-719 (May 1975).

The variations of the physical conditions in the gaseous envelope of the NGC 1275 nucleus discussed in a previous paper[5] are accompanied by variations in its [O III], [Ne III], and [S II] emission-line profiles. The profiles indicate that the [O III] and [O II] zones of this Seyfert-galaxy nucleus have a cloud structure. The electron density is greater than $8 \cdot 10^6$ cm^{-3} in the main [O III] zone but less than $1.5 \cdot 10^6$ cm^{-3} in the moving clouds. (auth)

15328 SPECTROSCOPIC MODELS FOR SEYFERT-GALAXY NUCLEI. Yankulova, I.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 18: No. 6, 720-729 (May 1975).

Models are developed for the gaseous envelopes around the nuclei of the Seyfert galaxies NGC 4151, 7469, 1068, 5548, 3227, and 4051, the regions in which the emission-line spectra are formed. The gas responsible for the line emission is in a quasiequilibrium state and is considered to be ionized by a central source with the power-law spectrum $F\nu = F_0(\nu_0/\nu)^\alpha$ egr·sec^{-1}·Hz^{-1}. The equation of ionization equilibrium and the energy-balance equation are solved simultaneously by successive approximations, resulting in a determination of the degree of ionization of H, He, O, Ne, N, and S. Dibai and Pronik's two-component model for the gaseous envelope of the nucleus is adopted, wherein a dense region 1 is embedded in a gradually expanding corona or halo (regions 2 and 3). The theoretical spectra are compared with observations. The models yield values for the outside diameters of the regions where the emission-line spectra are formed ($2r_3 \simeq 60$–120 pc), and they provide estimates for the mass of the radiating gas. In the dense inner region 1 the mass $\mathfrak{M}_1 \simeq$ (2–10) $\cdot 10^2 M_\odot$, while in regions 2 and 3, $\mathfrak{M}_2 + \mathfrak{M}_3 \simeq$ (2–20) $\cdot 10^4 M_\odot$. For the less prominent nuclei of NGC 3227 and 4051 these values are smaller: $\mathfrak{M}_1 \simeq 1$–$6 M_\odot$, $\mathfrak{M}_2 + \mathfrak{M}_3 \simeq$ (9–10) $\cdot 10^2 M_\odot$. The thickness of the gas layer in which the [O II], [N II], and [S II] emission lines are formed is computed to be about 11–14 Pc; this layer is in the outer part of the envelope (region 3). At the inner boundary of region 2 the electron temperature reaches a higher value than in region 1 (since the gas density there is lower than in region 1); it then gradually drops to (1.3–1.6) $\cdot 10^4$°K in the outer part of the envelope. The best agreement between the theoretical and observed sizes is obtained for a volume filling factor in the range $10^{-4} \leqslant \varepsilon \leqslant 10^{-3}$. With the NGC 4151 and 7469 nuclei as examples it is shown that a dense region 1 must necessarily be included in models for some nuclei, and that this region should be located in the central part of the nucleus. (auth)

15329 LARGE-SCALE DISTRIBUTION OF HYDROGEN IN GALAXIES. Zasov, A.V. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 18: No. 6, 730-733 (May 1975).

Quirk's suggestion that because of condensation of gas the large-scale distribution of hydrogen in the disks of the galaxies is connected to their rotational characteristics and the presence of density waves is confirmed and developed. (auth)

15330 INFRARED EMISSION FROM OH 284.2–0.8. Frogel, J.A.; Persson, S.E. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 197: No. 2, 351-353 (15 Apr 1975).

OH 284.2−0.8, a strong, peculiar OH emitter, has been found to be a bright infrared source less than 4″ in diameter, and to be associated with a knot of optical nebulosity. The general appearance of the infrared energy distribution resembles that of a compact H II region, although the emission shortward of 3.5 μ is relatively blue, and may contain a contribution from reddened starlight. There is an absorption feature at 3.1 μ, but no apparent emission or absorption features near 10 or 20 μ. (auth)

15331 THE C^+−CO TRANSITION IN INTERSTELLAR CLOUDS. Glassgold, A.E.; Langer, W.D. (New York University). Astrophys. J. 197: No. 2, 347-350 (15 Apr 1975).

Ionized carbon recombines as the ultraviolet radiation field is attenuated inside interstellar clouds. We propose that C^+ is transformed into CO, the CO being formed by ion-molecules reactions of C^+ with OH and H_2O. The characteristic column density of hydrogen required for the transition is $N \simeq 3 \times 10^{21}$ cm^{-2}. The C^+–CO transition has important implications for observations of CO and the thermal properties of sufficiently thick clouds. (auth)

15332 INTERSTELLAR MOLECULES: DIRECT FORMATION ON GRAPHITE GRAINS. Bar-Nun, A. (Department of Physical Chemistry, The Hebrew University, Jerusalem, Israel). Astrophys. J. 197: No. 2, 341-345 (15 Apr 1975).

It is demonstrated experimentally that ground-state atoms of oxygen, hydrogen, and sulfur, thermalized to 78 K, can, upon impinging on graphite grains, produce carbon monoxide and carbon dioxide, a variety of hydrocarbons, and carbon disulfide. Since interstellar extinction curves indicate the existence of bare graphite surfaces in the clouds, it is suggested that direct chemical reactions of atoms with graphite grains supply a considerable number of these molecules to the clouds. In clouds where the temperatures are not much below 78 K, the carbon oxides and most of the hydrocarbons will evaporate from the grains and will not contribute to mantle growth. (auth)

15333 SURFACE PHOTOMETRY OF GALAXIES. I. THE SB0 NGC 2950. Crane, P. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. 197: No. 2, 317-328 (15 Apr 1975).

Surface photometry of NGC 2950, a classic example of the SB0 type galaxy, is presented. The analysis shows that except for the rudimentary bar the galaxy closely resembles an S0 galaxy. The disk component has an exponential light curve with a central surface brightness of B (0) =21.65 per square second of arc and a scale size of 4.3 kpc. The nucleus, bar, and disk components contain 29, 22, and 48 percent, respectively, of the light. Integral and differential colors are presented and discussed in terms of the three components mentioned above. (auth)

15334 THE GALAXY M82: NUCLEAR LUMINOSITY AS DETERMINED BY THE POLARIZATION PATTERN. Solinger, A.B.; Markert, T. (Physics Department, Massachusetts Institute of Technology). Astrophys. J. 197: No. 2, 309-315 (15 Apr 1975).

The polarization pattern of M82 is considered anew and is shown to reflect the ratio of nuclear to disk luminosity. The M82 galactic disk is found to make a significant contribution to the scattered light, independent of type of scatterers assumed. Scattering theory is compared with the data, and this allows a determination of the nuclear luminosity, which is found to be $L_N = 10^{42.0 \pm .3}$ ergs s^{-1} in the visual. This is an order of magnitude brighter than previous estimates, and yet amounts to only 5 percent of the disk luminosity. Thus, the major portion of the scattered continuum beyond the M82 plane originates in the M82 galactic disk, and *not* in the nucleus. This, in turn, means that the polarized Hα line observed being scattered in the filaments may originate in the disk, leaving open the possibility that M82 is a Seyfert galaxy. Futher investigations may resolve this issue, and new observations are suggested to pinpoint various nuclear and disk parameters. (auth)

15335 THE ORIGIN OF INFRARED EMISSION FROM THE NUCLEUS OF NGC 1068. Jones, T.W. (Department of Physics, University of California, San Diego); Stein, W.A. Astrophys. J. 197: No. 2, 297-307 (15 Apr 1975).

Recent infrared observational results for the nucleus of the Seyfert galaxy NGC 1068 are reviewed and analyzed in terms consistent with information available at other wavelengths. It is concluded that the infrared and optical data imply that $\gtrsim 85$ percent of the infrared emission at 10μ is radiation from dust grains in the nucleus. Observed reddening of spectral lines implies geometrical optical depths at visual wavelengths ~7–15 if the nuclear dust cloud is approximately spherically symmetric. The dust grains emitting the infrared radiation could be silicates with a 10-μ optical depth near unity, but this

identification is not uniquely established. The grains are heated radiatively by an underlying source or sources of radiation also responsible for ionizing the emission-line-producing gas. The underlying source could be nonthermal, or it could be a hot plasma. Physical constraints on each of these models are derived. (auth)

15336 PROPERTIES OF TWO BLUE COMPACT GALAXIES. Arp, H.; O'Connell, R.W. (Hale Observatories, Carnegie Institution of Washington). Astrophys. J. 197: No. 2, 291-296 (15 Apr 1975).

An analysis of spectroscopic and photometric data for two blue, low-luminosity compact galaxies similar to the "isolated extragalactic H II regions" studied by Sargent and Searle is presented. The observed ionization and spectral energy distributions of both systems are consistent with a young stellar population dominated by hot stars $\lesssim 10^8$ years old. For one galaxy, CG 1116+51, a mass is obtained which leads to an unusually high mean surface density $\langle\mu\rangle \gtrsim 1800 M_\odot$ pc^{-2}. The observed mass cannot be unambiguously accounted for by the main-sequence luminosity function which prevails in the solar neighborhood, and the possibility that an unusually large fraction of the object's mass resides in uncondensed form remains open. Inferred rates of star formation and supernova explosions imply that both galaxies may be considered to be rapidly evolving compared with normal galaxies. (auth)

15337 STEPS TOWARD THE HUBBLE CONSTANT. VI. The Hubble Constant Determined From Redshifts and Magnitudes of Remote Sc I Galaxies: The Value of q_0. Sandage, A.; Tammann, G. A. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J.; 197: No. 2, 265-280(15 Apr 1975).

Newly measured redshifts are given for a sample of remote Sc I galaxies in the apparent magnitude range $13.5 \lesssim m_{pg} < 15.8$ that were found by inspecting 33 Palomar Sky Survey plates in both galactic polar caps. The redshifts range from 2700 to 21,000 km s^{-1}. These data, combined with redshifts and magnitudes for nearby Sc I galaxies, show a well-defined redshift-magnitude relation that follows the slope $dm^{0,i}_{pg}/d \log cz = 5$ required by the linear Hubble expansion. The distant and nearby samples define a common redshift-magnitude relation, which shows that the Hubble constant is the same for Sc I galaxies with $v \lesssim 2000$ km s^{-1} and $v \gtrsim 6000$ km s^{-1}. There is no evidence for a perturbed velocity field, and, in particular, the Sc I spirals in the Virgo cluster lie within $\sigma/2$ of the ridge line, confirming an earlier result from E cluster members that there is no measurable velocity anomaly of the Virgo cluster itself. A bias is identified, and the material is suitably restricted to change the sample from a magnitude-limited set to one that is distance-limited. The statistical properties of the unbiased sample, combined with the absolute magnitude calibration in Paper IV, give the Hubble constant to be $H_0 = 56.9 \pm 3.4$ km s^{-1} Mpc^{-1}. The order-of-magnitude agreement of H_0^{-1} with the age of globular clusters and of the chemical elements (for any value of the deceleration parameter in the range $0 \lesssim q_0 \lesssim 2$, as given by other data) is taken as good evidence, second only to the presence of the 3 K radiation, for an evolving Universe of the Friedmann big bang type. Upper limits for the deceleration parameter q_0 are calculated. Within the errors, the value of q_0 agrees with that found by summing the light from visible galaxies ($q_0 \simeq 0.03$), suggesting that a large fraction of the mass of the Universe may be in the galaxies, and that the expansion will never stop. (LBS)

15338 OBSERVATIONS OF INTERSTELLAR CH AND A STUDY OF ITS CHEMISTRY AND EXCITATION. Zuckerman, B. (University of California, Berkeley); Turner, B.E. Astrophys. J. 197: No. 1, 123-136 (1 Apr 1975).

The 140-foot telescope of the National Radio Astronomy Observatory was used to observe the three Λ-doublet transitions in the $^2\Pi_{1/2}$, $J=1/2$ state of interstellar CH. CH is detected mainly in optically dark nebulae and other, more distant, regions that are probably similar types of clouds. However, CH is not observed in many other dark clouds and globules, and is also not abundant in the very dense clouds associated with H II regions. Thus, the CH/(H + H_2) abundance ratio varies in molecular clouds in the galaxy from $\sim 10^{-8}$ to less than 10^{-9}. CH is much less abundant than OH, even in regions of apparently low extinction. It is also less abundant than H_2CO except in regions of low extinction and in some dark nebulae. Improved rest frequencies for the three CH hyperfine components are obtained. These are discussed in terms of the structure of the molecule. The three hyperfine lines are always observed in emission with relative intensities often far from those expected in local thermodynamic equilibrium. The CH ground state Λ-doublet population is generally inverted in the Galaxy, probably via special collisions with hydrogen molecules. The nonequilibrium hyperfine ratios probably result from radiative processes. The formation rate of CH is inadequate to explain the anomalous excitation in terms of selection of particular states during formation. Comparison is made between observed abundances and those predicted by some ion-molecule reaction schemes. (auth)

15339 THE EMISSION-LINE SPECTRUM OF NGC 1068. Shields, G.A. (Center for Astrophysics, Harvard College Observatory—Smithsonian Astrophysical Observatory); Oke, J.B. Astrophys. J. 197: No. 1, 5-16 (1 Apr 1975).

We report new photoelectric observations of the nucleus of NGC 1068 and an analysis of the emission-line intensities. The derived reddening is $E_{B-V} = 0.4$, in agreement with an earlier determination by Wampler. The line intensities indicate a filamentary geometry characterized by two densities, 2×10^5 cm^{-3} and 800 cm^{-3}. An exponential extrapolation of the optical nonthermal continuum leads to an ultraviolet continuum sufficient to ionize the emission-line region; other continuum forms are also possible. Detailed models show that steady-state photoionization can explain many of the observed line intensities, including [O I]; but the predicted intensities of [O II] and [S II] are too weak. However, strong [O II] and [S II] emission can result from time-dependent ionization due to continuum variability or to motion of photoionized gas into shadows of condensations. Our results support the hypothesis that the emission-line region of NGC 1068 is ionized by ultraviolet radiation rather than cloud collisions. Assuming a solar oxygen abundance, we find a nitrogen abundance N (N)/N (H) $=4\times10^{-4}$, which is larger than the solar value, but similar to the high value in the nuclei of normal galaxies. (auth)

15340 THE NUCLEUS OF NGC 253. Rieke, G.H.; Low, F.J. (Lunar and Planetary Laboratory). Astrophys. J. 197: No. 1, 17-23 (1 Apr 1975).

Detailed mapping and photometry of the nucleus of NGC 253 has been carried out from 1.6 through 34 μ. Most of the 10-μ flux comes from a region ~45 pc in diameter; the 2.2 μ source is more extended. The 10-μ core is visible in near-infrared photographs and is at the position of a compact radio source. The "silicate" absorption feature at 10 μ varies in strength across the source, indicating strong, nonuniform interstellar extinction. The ratio of the optical depth in the feature to the visual extinction is similar to that found toward our galactic center. The M/L ratio in the nucleus is less than ~0.1; therefore, thermonuclear burning of the mass currently in the nucleus could not have sustained the present level of emission for the life of the galaxy. (auth)

15341 LINE-LEAKING MODELS FOR INTERSTELLAR MOLECULAR EMISSION AND ABSORPTION. I. Pelling, M. A.; ter Haar, D. (Oxford Univ.). Mon. Not. R. Astron. Soc.; 171: No. 1, 103-118(Apr 1975).

A line-leaking (radiative transfer) theory is sketched with special reference to the absorption and emission by interstellar formaldehyde. The model, in which population inversions or anti-inversions are produced because radiation has leaked out of some of the frequencies corresponding to the transitions between relevant levels, is applied to several formaldehyde sources, such as the Ori A emission and absorption sources, the Heiles dark clouds, and several H I and H II sources. On the whole reasonable agreement with observational data is obtained. (auth)

15342 STUDIES OF RICH CLUSTERS OF GALAXIES. III. Photometry of the Cluster A1930 and the m*-z Relation. Austin, T. B.; Godwin, J. G; Peach, J. V. (Oxford Univ.). Mon. Not. R. Astron. Soc.; 171: No. 1, 135-142(Apr 1975).

Photometry is presented for objects in the central region of the cluster A 1930. There is no evidence of radial luminosity or color segregation. The discontinuity in the integrated luminosity function occurs at a total absolute magnitude $M_v^* = -21.0$. The extension of Bautz and Abell's data to higher redshift made by this cluster and A 1413 confirms that M_v^* is a better distance indicator than the apparent magnitude of the brightest cluster member. The low dispersion of M_v^* is used directly to obtain a value for the Hubble constant at the Virgo cluster of H_0(VC) = 62 ± 19 km s^{-1} Mpc^{-1}. (auth)

15343 ELECTRONOGRAPHIC MEASUREMENTS OF THE DENSITY STRUCTURE OF NGC6543 USING THE O^+ AND Cl^{++} IONS. Dopita, M. A.; Gibbons, A. H. (Univ. of Manchester, Eng.). Mon. Not. R. Astron. Soc.; 171: No. 1, 73-83(Apr 1975).

Measurements have been made with the electronographic image tube spectrograph on the Isaac Newton Telescope of the [O II] doublet λ 3726, 3729 Å and the [Cl III] doublet λ 5537, 5517 Å at 80 and 140 positions respectively in the planetary nebula NGC 6543. A temperature is found from the ratio of the Balmer Jump to the sum of H15, H16 and H17. The electron density as indicated by the O^+ ions is found to vary from 1500 to 5000 cm^{-3} and that indicated by the Cl^{++} ions to vary from 3000 to 6500 cm^{-3}. No correlation between the two density structures was found indicating that the real local density fluctuations found are in no way continuous through variations in excitation conditions. (auth)

15344 PHOTOELECTRIC PHOTOMETRY OF SUPERGIANTS IN THE LARGE MAGELLANIC CLOUD. Isserstedt, J. (Ruhr

Univ., Bochum, Ger.). Astron. Astrophys., Suppl. Ser.; 19: No. 3, 259-269(Mar 1975). (In German).

Photoelectric photometry for 392 supergiants in the Large Magellanic Cloud is presented (table 2). The catalogue contains almost all stars of luminosity class I and almost all OB stars with $m_{pg} \leq 12^m.5$ taken from the spectral survey of Sanduleak (1969), which had not already been measured by Ardeberg et al. (1972). The mean errors are in the average $\pm 0^m.020$ in B-V and $\pm 0^m.025$ in V and U-B. Identification (column 1) and spectral type of the stars (column 6) have been taken from Sanduleak. (auth)

15345 SMALL MAGELLANIC CLOUD. First List of Probable Members. Azzopardi, M.; Vigneau, J. (Observatoire du Pic-du-Midi, Toulouse). Astron. Astrophys., Suppl. Ser.; 19: No. 3, 271-279(Mar 1975).

An objective-prism survey in the direction of the Small Magellanic Cloud has enabled the detection of many new stars which show high luminosity spectral characteristics. The use of interferential filters has allowed reaching fainter stars, by cutting down on the background fog and limiting to a minimum the overlappings. A first list is given of 63 stars for which photoelectric photometry measurements in the UBV system have been made. These results are compared with those for 53 stars known to be SMC members. Identification charts are provided. (auth)

15346 RGU THREE COLOR PHOTOMETRY IN THE LARGE SAGITTARIUS CLOUD. Gschwind, P. (Univ. of Basel). Astron. Astrophys., Suppl. Ser.; 19: No. 3, 281-302(Mar 1975).

A field of 0.14 sq. degrees containing 2220 stars, in the direction of the galactic centre has been measured on 17 48'' Palomar Schmidt plates in the RGU system down to a limiting magnitude of 16.5 mag. in G. A comparison between the late-type giants and the main-sequence stars of the same absolute magnitude shows the existence of two different groups of late-type giants with normal positions at the left and at the right side of the late main-sequence branch, as has been found also in other directions. The interstellar reddening is caused by four absorption screens between 150 and 3000 pc with a total absorption of 1.89 mag., followed by strongly increasing values for distances over 7500 pc. The empirical density function of the late-type giants has a maximum between 1.8 and 2.4 kpc. If the dispersion in the absolute magnitude is taken into consideration a flatter density function with a somewhat larger distance for the maximum is found. The density functions of the main-sequence stars, show also a maximum, within the limit of completeness, lying some hundred parsecs nearer than the one of the late-type giants. These density maxima coincide approximately with the next inner spiral arm. The luminosity functions for the distance intervals 400 to 600 pc and 1 to 2 kpc reflect the behavior of the density functions. (auth)

15347 VELOCITIES WITH GRATING AND FABRY-PEROT SPECTROGRAPHS OVER THE IONIZED GAS OF M31. Deharveng, J. M.; Pellet, A. (Observatoire, Marseille). Astron. Astrophys., Suppl. Ser.; 19: No. 3, 351-358(Mar 1975). (In French).

A Fabry-Perot interference method (mean dispersion 25 Å/mm and 15.5 Å/mm) has given 1389 radial velocities of Hα, in the arms of M31. Mean rotation velocities are computed by grouping measured points according to the morphology. (auth)

15348 OPTICAL POSITIONS OF BRIGHT GALAXIES. III. Gallouet, L.; Heidmann, N.; Dampierre, F. (Observatory of Paris). Astron. Astrophys., Suppl. Ser.; 19: No. 1, 1-19(Jan 1975).

The last part of the catalogue of optical positions of the 2118 galaxies at declination higher than $-33°$ in the Reference Catalogue of Bright Galaxies, by G. and A. de Vaucouleurs (1964), is presented. The present list, which contains 557 galaxies, covers the range $-33°$ to $-2°$ in declination. The accuracy is a few seconds of arc. (auth)

Cosmology

Refer also to abstracts 15105, 15204, 15292, 15337, 15650, 16170, 16171, and 16176.

15349 LIOUVILLE'S THEOREM AND THE THIRD INTEGRAL OF MOTION FOR STEADY-STATE STELLAR SYSTEMS. III. Hydrodynamical Analogy and Some Special Cases. Osipkov, L. P. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; 19: No. 4, 136-144(Oct 1974). (In Russian).

Some hydrodynamical properties of monotach star streams are discussed. The most attention is paid to the case when such streams are unvortex. It is suggested that the corresponding integrals of motion should be called fundamental. (auth)

15350 TIME VARIATION OF THE ATOMIC MASS AND DISCREPANT RED SHIFTS. Chow, T. L. (California State Coll., Turlock). Lett. Nuovo Cim.; 12: No. 4, 545-546(5 Apr 1975).

The gravitational theory proposed by Hoyle and Narlikar is briefly described. In response to the theory, a calculation is presented that refutes the time variation of atomic masses. It is concluded that the theory probably cannot account for discrepant red shifts. (SDF)

15351 ORIGIN OF THE KINETIC ENERGY OF EXPANSION OF THE UNIVERSE IN THE FERMI ENERGY OF THE YLEM. Levitt, L. S. (Univ. of Texas, El Paso). Lett. Nuovo Cim.; 12: No. 14, 537-541(5 Apr 1975).

The ratio of kinetic to potential energies of the expanding universe is derived from simple considerations and is shown to be at variance with the value predicted by the Gamow theory of the origin of the universe. The source of the kinetic energy of expansion is discussed assuming a ylem composed of Eddington's number of neutrons and the radius of the primordial nucleus is calculated in good agreement with previous estimates. The model described predicts a universe oscillatory in space and time. (SDF)

15352 INDIRECT CONFIRMATION OF HIERARCHIAL COSMOLOGICAL MODELS. Kalinkov, M.; Stavrev, K. (Dept. of Astronomy, Sofia). Compt. Rend. Acad. Bulg. Sci.; 28: No. 1, 13-16(1975).

The existence of second-order clusters of galaxies and hints for third-order clusters is cause to question homogeneous models of the Universe. The direct check of the special hierarchical models for the valves of the thinning rate has been carried out by analysis of the velocity field of 30 clusters of galaxies having $CZ < 10^4$ km and galaxy counts. Results show that there are areas on the celestial sphere for which the galaxy counts are in agreement with a model of a hierarchical Universe. (BJG)

15353 RESULTS OF THE MUNICH–FRASCATI GRAVITATIONAL-WAVE EXPERIMENT. Billing, H.; Kafka, P.; Maischberger, K.; Meyer, F.; Winkler, W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Lett. Nuovo Cim.; 12: No. 4, 111-116(25 Jan 1975).

Two detectors were built to confirm or disprove the existence of gravitational pulses. An equivalent circuit of Weber-type detectors is used enabling the calculation of the optimal filter and sensitivity for a given kind of signal. Coincident data reveals no short pulse stronger than 0.5 kT in 150 days, on the average less than 7 pulses per day > 0.1 kT and less than 500 per day > 0.025 kT. The probability of the largest peak being accidental is estimated to be about 1.5%. (BJG)

15354 ESTIMATE OF THE MEAN DENSITY OF MATTER IN THE METAGALAXY. Arakelyan, M. A. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 84-85(1973).

Translated from Astrofizika; 9: No. 1, 151-153(1973).

A new method of constructing a reliable luminosity function for low-luminosity galaxies is discussed. The relatively high density of low luminosity objects among Markaryan galaxies indicates indirectly that the spatial density of dwarf field galaxies and of such objects in the immediate neighborhood of our galaxy is similar. Estimates of the spatial density of dwarf galaxies are derived from data on the seven nearest galaxies (magnitude -15.0 to -13.0) and compared with the luminosity function of field galaxies. It is reasoned that the metagalactic field is more homogeneous with respect to dwarf galaxies than with respect to galaxies of high luminosity. (BJG)

15355 GRAVITATIONAL-ELECTROCHEMICAL EFFECT AND ITS USE IN CREATING A DETECTOR OF GRAVITATIONAL RADIATION. Krustev, G. A. (Plovdiv Univ., Bulgaria). Compt. Rend. Acad. Bulg. Sci.; 28: No. 1, 17-20(1975).

There exists a gravitational-electrochemical effect of gravitational waves in electrochemical systems on the basis of which a detector of gravitational radiation can be plotted. A highly sensitive quantum mechanical effect at physical circuits manifests itself in such a device. This effect may supply a new method for converting the energy of gravitational waves into electrical energy by means of physiochemical reactions. A receiver using piezocrystals is proposed based on this effect. (BJG)

15356 COSMOLOGICAL MODEL OF SPACE-TIME TORSION. Ponomarev, V. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 6, 730-735(1974). (In Russian).

A simple non-trivial model of space-time with torsion, i.e., an isotropic and homogeneous universe, was examined. It was shown that the torsion effect is the effect of the type of curvature. (tr-auth)

15357 MISSING MASS IN THE UNIVERSE. Field, G. pp 289-317 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

It is pointed out that hot, ionized gas seems a better possibility than galaxies and neutral gas for binding the universe depending on the clumping factor, which is unknown. Both in clusters and outside of them these would have to be tremendous energy sources like quasar explosions to heat the gas to the very high temperature required by the x-ray observations. (JFP)

15358 EVOLUTION OF IRREGULARITIES IN AN EXPANDING UNIVERSE. Peebles, P. J. E. (Princeton Univ., NJ). pp 318-350 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

A discussion is given of some aspects and a phenomenological picture for the development of irregularity in an expanding universe. (JFP)

15359 VISCOUS UNIVERSES WITHOUT INITIAL SINGULARITY. Heller, M.; Klimek, Z. (Uniwersytet Jagiellonski, Krakow (Poland). Obserwatorium Astronomiczne). Astrophys. Space Sci.; 33: No. 2, L37-L39(Apr 1975).

It is shown that within a certain class of cosmological models (homogeneity and isotropy, two-component noninteracting fluid, density-dependent coefficient of bulk viscosity) the introduction of bulk viscosity effectively removes the initial singularity. (auth)

15360 ENERGY CONDITIONS AND INHOMOGENETIES IN THE UNIVERSE. Heller, M. (Uniwersytet Jagiellonski, Krakow (Poland). Obserwatorium Astronomiczne). Astrophys. Space Sci.; 33: No. 2, L33-L35(Apr 1975).

The so-called dominant energy condition and the strong energy condition (of singularity theorems) cannot be violated by the negative effective "pressure" arising from the inhomogeneous distribution of matter in the Universe. (auth)

15361 EXISTENCE AND AMOUNT OF INTERGALACTIC DUST. Schmidt, K.-H. (Zentralinstitut fuer Astrophysik der Akademie der Wissenschaften der Deutschen Demokratischen Republik, Sternwarte Babelsberg, German Democratic Republic). Astrophys. Space Sci.; 34: No. 1, 23-31(Apr 1975).

From symposium on solid state astrophysics; Cardiff, U.K. (9 Jul 1974).

The existence of intergalactic dust has been proved by the following observational facts: the decrease of the numbers of distant galaxies and clusters of galaxies behind the central regions of near clusters of galaxies; the different distributions of RR Lyrae stars and galaxies near 1 Microscopii (Hoffmeister's cloud); the dependence of colour excesses of galaxies on supergalactic coordinates as well as on the surface density of bright galaxies; the colour index vs redshift correlation of quasistellar objects. The densities of intergalactic dust are estimated to be between 5×10^{-30} g cm^{-3} (near the centers of clusters of galaxies) and 2×10^{-34} g cm^{-3} (near the centers of clusters of galaxies) and 2×10^{-34} g cm^{-3} (in general intergalactic space). The grains may be formed either in the early phases of the Universe ($25 < z < 50$) or may be expelled from galaxies by the radiation pressure. The most effective destruction process seems to be the evaporation by soft cosmic rays. (auth)

15362 NEW GRAVITATIONAL RADIATION EXPERIMENTS. Weber, J.; Lee, M.; Gretz, D. J.; Rydbeck, G. (Maryland Univ., College Park (USA)); Trimble, W. L. (California Univ., Irvine (USA); Maryland Univ., College Park (USA)); Steppel, S. (Stanford Linear Accelerator Center, Calif. (USA); Maryland Univ., College Park (USA)). pp 23-32 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

Coincidence experiments were repeated with gravitational radiation detectors at the University of Maryland and the Argonne National Laboratory, at opposite ends of a 1000 kilometer baseline. These experiments differ from earlier ones in that the sensitivity is improved by about one order; the squares of the time derivatives of the output powers are written on magnetic tape. Without further filtering, a computer records the times thresholds are exceeded, to 0.1 second accuracy for each detector, and the dates and times of coincidences. The accidentals rate is measured by repeating the procedure for a sequence of time delays in one channel and the other. A significant excess of coincidences is found at zero delay. (FR)

15363 THE UNIVERSE AS A BLACK HOLE. Freeman, I.M. (Department of Physics, Rutgers University, New Brunswick, New Jersey 08903). Am. J. Phys. 43: No. 7, 644-644 (July 1975).

Using only Newton's law of gravitation and the classical expression for centripetal force, the black hole radius is derived. (AIP)

15364 EVIDENCE FOR A SPATIALLY HOMOGENEOUS COMPONENT OF THE UNIVERSE: SINGLE GALAXIES. Turner, E.L. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington); Gott, J.R. III. Astrophys. J. Lett. 197: No. 3, L89-L93 (1 May 1975).

A study of the distribution in the sky of galaxies brighter than 14th magnitude reveals two populations. One strongly clustered population has a covariance function $w(\theta) \sim \theta^{-1}$ and contains roughly 60 percent of all galaxies. The remaining galaxies are distributed almost uniformly with $w(\theta) \simeq 0$. The two populations are defined by the presence or absence (respectively) of nearby ($\lesssim 45'$) companions. The implications for the definition of clusters and the field, the growth of structure in the universe, and cosmology are discussed briefly. (auth)

15365 COMPTONIZATION, THE BACKGROUND-RADIATION SPECTRUM, AND THE THERMAL HISTORY OF THE UNIVERSE. Illarinov, A.F.; Syunyaev, R.A. (Institute of Applied Mathematics, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 6, 691-699 (May 1975).

Any type of energy releases (such as that associated with the dissipation of large-scale motions or antimatter annihilation) taking place early in the expansion of the universe (for red shifts in the range $10^8 > z > 10^2$) should alter the spectrum of the primordial background radiation. Each phase of the expansion will be typified by its own particular spectrum distortions. Hence if the background radiation were discovered to depart from a Planck spectrum, valuable information could be gained about the thermal history of the universe. Observations in the Rayleigh-Jeans part of the spectrum would be of special interest. The characteristic spectra are produced through the combined operation of Compton and free-free processes. Analytic equations are derived for the parameters of the distorted spectra, and calculations are performed for some particular cases. Constraints are placed on the magnitude of the energy release at different phases of the expansion. The primordial radiation now observed is shown to have been generated when $z > 10^8$. (auth)

15366 EVOLUTION OF COSMOLOGICAL TURBULENCE. III. SPECTRUM OF DENSITY INHOMOGENEITIES PRODUCED BY TURBULENCE. Kurskov, A.A.; Ozernoi, L.M. (Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Astron.—AJ 18: No. 6, 700-707 (May 1975).

If at the close of recombination (red shift $z \simeq 900$) the maximum damped turbulence scale R_d exceeds only slightly the scale $\hat{R}$ of hydrodynamically "frozen" motions in the absence of dissipation, then practically all matter (except for an exponentially small part) will evolve by the "calm" mode, with no shock waves formed immediately after recombination. The spectrum of density inhomogeneities generated by cosmological turbulence both before and after the onset of recombination is calculated for this situation. By the time recombination has concluded for scales in the range contracting a mass $M \gtrsim 10^{12}(\Omega h^2/0.2)^{-7/2} M_\odot$, [Eq. (4.6)] nonisentropic density inhomogeneities will remain, formed through exponential damping of the turbulent velocities by radiative viscosity (at the stage of large optical depth) and kinetic damping (when the optical depth has become small). In the mass range $10^{12}(\Omega h^2/0.2)^{-7/2} M_\odot \lesssim M \lesssim 10^{17}(W/0.2)^3 (\Omega h^2/0.2)^{-2} M_\odot$, the predominant inhomogeneities will be formed through generation of irrotational velocities by vortical velocities when pressure is removed at the epoch of recombination. For masses $M \lesssim 10^{17}(W/0.2)^3 (\Omega h^2/0.2)^{-2} M_\odot$ [Eq. (4.8)], inhomogeneities produced through the radiation of sound generated by the turbulence may predominate. (auth)

15367 ON NEUTRINO ABSORPTION IN COSMOLOGY. Burman, R. (Western Australia Univ., Nedlands. Dept. of Physics). Phys. Lett., A; 53: No. 1, 17-18(19 May 1975).

This letter deals with the self-consistency or otherwise, in the absorber theory of radiation, of retarded and advanced neutrino fields in the Robertson-Walker cosmologies. (auth)

15368 TURBULENCE IN COSMOLOGY. I. The Effect of the Strong Turbulence on the Early Evolution of the Universe. Marochnik, L. S.; Pelikhov, N. V.; Vereshkov, G. M. (Rostovskijna-Donu Gosudarstvennyj Univ. (USSR)). Astrophys. Space Sci.; 34: No. 2, 249-263(May 1975).

Principles of the theory of turbulence in relativistic cosmology are developed. By averaging Einstein's equations over stochastic fields a self-consistent system of equations is obtained which describes statistically: the influence of the turbulence on the basic state of the Universe (the background) on which the turbulence develops; the behavior of the turbulence on the background "distorted" by it. By means of a qualitative study of exact equations in the region of a strong turbulence at an early

stage of cosmological expansion conditions of the absence of singularity are found and the possibility of stationary solutions in the homogeneous, isotropic, on the average, Universe (the cosmological constant $\Lambda = 0$) is shown. The rate of cosmological expansion increases if the energy density of the turbulence is positive, and decreases if it is negative. The latter alternative takes place if the absolute value of the energy density of excitations, which will change into potential motions in the future, exceeds the energy density of the remaining part of the turbulence. (auth)

15369 TURBULENCE IN COSMOLOGY. II. The Asymptotic Effect of Collective Excitations on the Cosmological Expansion of the Homogeneous and Isotropic, on the Average, Universe. Marochnik, L. S.; Pelikhov, N. V.; Vereshkov, G. M. (Rostovskij-na-Donu Gosudarstvennyj Univ. (USSR)). Astrophys. Space Sci.; 34: No. 2, 281-295(May 1975).

At the stage of a weak turbulence the interactions between excitations are negligible, and potential, vortical and gravitational perturbations may be considered independent. In this approximation the analytical solutions to exact equations of the turbulence theory are found. It is shown that only such excitations whose effective equations of state do not coincide with those of matter do contribute to the deviation from the Friedmann law. At the stage $p = \frac{1}{3}\epsilon$ this involves potential and vortical turbulences. A model of the Universe from gravitational waves is constructed. The influence of the turbulence on the course of the expansion is essential till the beginning of, and probably during, the synthesis of light elements. The rate of cosmological expansion and gravitational instability decreases if the potential turbulence predominates over the vortical one, and increases in the opposite case. (auth)

15370 DIFFRACTION OF LIGHT AND LENS EFFECT OF THE STELLAR GRAVITATION FIELD. Bliokh, P. V.; Minakov, A. A. (AN Ukrainskoj SSR, Kharkov, Inst. Radiofiziki i Ehlektroniki). Astrophys. Space Sci.; 34: No. 2, L7-L9(May 1975).

The focusing of light by gravitational "lenses" (stars) is considered. Finite estimates of the gain q on the optical axis ($r \to 0$) can be obtained with an account of diffraction of light. (auth)

15371 PROPAGATION OF ELECTROMAGNETIC POLARIZATION EFFECTS IN ANISOTROPIC COSMOLOGIES. Brans, C.H. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. 197: No. 1, 1-4 (1 Apr 1975).

The influence of a background cosmological metric on the propagation of electromagnetic radiation through the universe is studied, with particular emphasis on the effect of metric anisotropies on polarization properties. An approximation is used which regards the electromagnetic field as a flat-space plane wave (null field) with respect to the Minkowski frames parallel-transported along a null geodesic. These frames are Lorentz transforms of the local comoving cosmological frames at each point. Thus the effects of the metric on the electromagnetic field show up in terms of these Lorentz transformations. It is found that a general anisotropic metric will produce rotations of planes of polarization by amounts dependent on the length of the path, causing a scrambling of any polarization effects from different sources. (auth)

15372 EFFECTS OF PRIMORDIAL FLUCTUATIONS ON THE ABUNDANCES OF LIGHT ELEMENTS. Epstein, R.I. (Lawrence Livermore Laboratory, Livermore, California); Petrosian, V. Astrophys. J. 197: No. 2, 281-284 (15 Apr 1975).

Some of the effects of primordial inhomogeneities on the production of ^{2}H, ^{3}He, and ^{7}Li are investigated. For the most part, temperature fluctuations have only small effects on the abundances. The density fluctuations are modeled by an unimodal distribution so that the Universe is characterized by the mean density and the relative amplitude of the density variations. We have found that the constraint which ^{2}H production imposes on the mean mass density is eased somewhat by allowing for density inhomogeneities. However, unless the composition of the interstellar matter is atypical of most of the matter in the Universe, the mass density will be at least a factor of 3 below the critical density. For reasonable estimates of the pregalactic abundances, sufficient ^{3}He and ^{7}Li cannot be produced in the same model universe. Production of both ^{7}Li and ^{3}H requires large-amplitude primordial fluctuations, while sufficient ^{3}He and ^{2}H can be formed in very low density, fairly homogeneous universes. (auth)

15373 ON THE ABILITY OF CURRENT EXPERIMENTS TO TEST π^0-DECAY GAMMA-RAY BACKGROUND THEORIES. Montmerle, T. (Département de Physique, Université de Montréal). Astrophys. J. 197: No. 2, 285-289 (15 Apr 1975).

In some theories for the 1–100 MeV γ-ray background some definite features are predicted (e.g., matter-antimatter regions annihilating in the case of the Stecker-Puget theory) as a function of redhisft. However, the theoretical possibility of observing these features at any redshift up to $z_c \simeq 100$ is, in the case of π^0-decay theories, rather restricted with present experiments, and this is shown by the introduction of a "visibility function" which folds the theoretical γ-ray background intensity as a function of redshift through the efficiency of a given experiment. The study of the spatial structure of the γ-ray background at high redshifts ($\lesssim z_c$) is potentially best accomplished by low-energy γ-ray experiments. (auth)

15374 QUANTUM COSMOLOGY: EXACT SOLUTION FOR THE GOWDY T^3 MODEL. Berger, B.K. (Joint Institute for Laboratory Astrophysics, University of Colorado, and National Bureau of Standards, Boulder, Colorado 80302). Phys. Rev. D 11: No. 10, 2770-2780 (15 May 1975).

A complete set of orthonormal wave functions valid at all times including that of the classical singularity is obtained in closed form for each mode of the quantized Gowdy T^3 universe. These wave functions are superposed to yield that wave function for each mode which reduces to a given initial state near the classical singularity. The expected number of quanta in each mode at times far from the singularity is obtained and depends only on the constants which characterize the initial state. All expectation values agree with those obtained classically and semiclassically except for a smearing out of the essentially classical picture due to quantum fluctuations. The precise description of the initial state at the singularity yields a model with the size and shape parameter of the universe satisfying an initial free-particle–like equation and later captured in the N-quantum state of a rising harmonic-oscillator potential. This contrasts with the graviton creation from vacuum fluctuations description of an earlier treatment by Berger. Misner has shown that the Gowdy T^3 model universe may be described as a scattering process in minisuperspace. He obtains a Klein-Gordon equation for the wave function of the universe which is separable in Fourier components of the wave part of the gravitational field. It is shown here that exact solutions exist for the Klein-Gordon equation which reduces for each mode to the Schrödinger equation for a time-dependent-frequency harmonic oscillator. The methods of Salusti and Zirilli are used to obtain wave functions characterized by the quantum number N with harmonic-oscillator spatial (in superspace) dependence and time-dependent coefficients. These N-quantum wave functions are fixed uniquely by requiring agreement with the known large-time-limit wave functions. Initial states are constructed for each mode near the time of the classical singularity which are wave packets characterized by an initial position and an initial momentum. These states form an overcomplete family of states. Their expectation values follow the classical equations of motion. (auth)

15375 EFFECT OF VISCOSITY ON THE CHARACTER OF THE COSMOLOGICAL SINGULARITY. Belinskiĭ, V.A.; Khalatnikov, I.M. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). JETP Lett. 21: No. 4, 99-100 (20 Feb 1975).

We consider the character of the solutions for a homogeneous anisotropic cosmological model of Bianchi type I, with allowance for the second viscosity. It is shown that the viscosity is unable to eliminate the cosmological singularity, in contrast to the previously investigated Friedmann case. The model considered in the present paper has the remarkable property that near the cosmological singularity the gravitational field produces matter within the framework of the classical (rather than quantum) theory. (auth)

15376 JEAN'S TYPE GRAVITATIONAL INSTABILITY OF FINITE ISOTHERMAL GAS SPHERES. II. Yabushita, S. (Kyoto Univ.). Mon. Not. R. Astron. Soc.; 171: No. 1, 85-86(Apr 1975).

It has recently been found that there is an extra factor γ in the boundary condition adopted in an earlier analysis of gravitational instability of isothermal gas spheres. It is shown that when the boundary condition is corrected, the general conclusion already arrived at remains true and that there are minor changes in the non-dimensional parameter which specifies neutrally stable configurations. (auth)

15377 PORTHOLE EFFECT AND RINGS OF FIRE IN FINITE METAGALAXIES. Breuer, R. A.; Ryan, M. P. (Oxford Univ.). Mon. Not. R. Astron. Soc.; 171: No. 1, 209-218(Apr 1975).

If the metagalaxy we live in is finite and surrounded by other metagalaxies within a larger universe then it is shown that radiation from outside would produce a bright ring in the direction closest to the "edge" of our metagalaxy. The possible absence of any such effects is also discussed and it is argued that the 3 K blackbody radiation might not have originated within our metagalaxy. The appearance of the outside world (radiation incoming from infinity) to an observer freely falling into a Schwarzschild black hole is separately calculated. (auth)

Planetary Phenomena

Refer also to abstracts 15194, 15242, and 15316.

15378 (N-75-11814) LUNAR SOIL FROM THE SEA OF FERTILITY. Vinogradov, A. P. (ed.). Oct 1974. Translation

of Lunnyy grunt iz Morya Izobiliya, Nauka Press, Moscow, 1974. (NASA-TT-F-15881). 642p. NTIS $15.25.

The collection contains articles by Soviet and foreign authors on the investigation of lunar surface materials returned by the Soviet Tuna 16 automatic station. Physical and mechanical properties of the lunar surface material are examined; many studies deal with mineralogical investigation and analysis of the chemical composition and distribution of rare elements in the regolith, and individual rock and mineral fragments. Constituents incorporated in the regolith are represented by both primary magmatic lunar rock as well as by formations emerging at the lunar surface during the long history of the moon. Of great importance are studies determining, by geochronological methods, the age of regolith and individual particles of magmatic rocks demonstrating their great age and that their age is comparable with the age of the earth and its most ancient geological formations. (auth)

15379 JOVIAN PROTONS AND ELECTRONS: PIONEER 11. Trainor, J. H. (Goddard Space Flight Center, Greenbelt, MD). McDonald, F. B.; Stilwell, D. E.; Teegarden, B. J.; Webber, W. R. Science; 188: No. 4187, 462-465(2 May 1975).

A preliminary account of the Pioneer 11 passage through the Jovian magnetosphere using data from the low-energy telescope (LET-II) is given. Representative electron and proton rates (up to approximately 2 MeV) are sampled over eight angular sectors to study particle anisotropies. It was found that Io is able to remove almost completely the lower energy (1.2 to 2.1 MeV) proton. A Jovian-orbiting satellite in a highly inclined orbit could have a reasonable lifetime before radiation damage becomes a problem. (BJG)

15380 CHEMICAL ABUNDANCES AND PHYSICAL CONDITIONS IN PLANETARY NEBULAE. Barker, P. T. Santa Cruz, CA; Univ. of California (1974). 117p. University Microfilms Order No. 75-8472.

Thesis (Ph. D.).

Photoelectric scanner observations have been made of the intensities of a number of emission lines between lambda 3400A and lambda 7400A in thirty planetary nebulae. The electron temperatures and densities implied by different forbidden line intensity ratios agree well for most nebulae, although there is evidence for large variations in three self-absorbed nebulae. The relative abundances of H, He, Ne, O, and, less reliably, N and S, were determined for thirty planetaries and for several planetaries observed by others. There is some evidence for a radial galactic abundance gradient in He, N, and possibly O and Ne. All nebulae (except the previously-studied planetary in the galactic halo and the one in the globular cluster M 15) have nearly the same abundances of O and Ne. (auth)

15381 INVALID 4.01-GYR MODEL U–Pb AGE OF THE NAKHLA METEORITE. Hutchison, R.; Gale, N. H.; Arden, J. W. (British Museum, London). Nature (London).; 254: No. 5502, 678-680(24 Apr 1975).

The Nakhla meteorite is an achondrite composed mainly of the minerals diopside and olivine, and is possibly a unique meteorite. It has a ^{39}Ar-^{40}Ar age of about 1.3 Gyr and it has been shown that its Rb-Sr age is similar (Papanastassiou and Wasserburg. Geophys. Res. Lett.; 1: 23 (1974)). It was previously considered that the meteorite originated in a differentiated planetary body not unlike the earth and that this parent body suffered gross differentiation between 3.6 and 1.37 Gyr ago. It is shown that the U-Pb systematics of Nakhla are inconsistent with some of the assumptions required for the calculation of a model U-Pb "age", thus indicating that model "ages" for other radioactive decay schemes may be invalid. The U and Pb contents and the atomic ratios $^{207}Pb/^{204}Pb$ and $^{206}Pb/^{204}Pb$ were determined for three bulk samples of the meteorite, and mean model "ages" were found to be about 4.01 Gyr. The various assumptions that must hold for a model "age" calculation to be valid when the U-Pb system is employed are stated. (UK)

15382 GRAINS ACCRETION PROCESSES IN A PROTO-PLANETARY NEBULA: CONDUCTING AND INSULATING MATERIALS. Carusi, A.; Coradini, A.; Federico, C. (Rome Univ. (Italy)); Fulchignoni, M.; Magni, G. (Consiglio Nazionale delle Ricerche, Frascati (Italy). Lab. di Astrofisica Spaziale). Astrophys. Space Sci.; 33: No. 2, 369-384(Apr 1975).

In a previous work the authors estimated cross-sections for constructive and destructive collisions ("constructive" and "destructive" cross-sections) related to silica grains embedded in a proto-planetary nebula. The outstanding point of the problem has induced the authors to examine more closely the physical conditions in which the accretion processes occur, and their dependence on the materials, by which the particles are probably made. In this paper the interaction processes among conducting grains (iron, graphite) and among the insulating (silica) ones have been considered. The following results have been obtained (1) insulating grains have smaller constructive cross sections than conducting; and (2) conducting grains show very large cross sections for masses up to about 10^{-3}g. (auth)

15383 ASTEROIDS: SPECTRAL REFLECTANCE AND COLOR CHARACTERISTICS. II. McCord, T.B. (Planetary Astronomy Laboratory, Massachusetts Institute of Technology); Chapman, C.R. Astrophys. J. 197: No. 3, 781-790 (1 May 1975).

We present new spectrophotometry for 31 asteroids, and improved data for nine previously observed, raising our total sample to 98. Several important new spectral types have been found. Asteroid 349 Dembowska is the first large main-belt asteroid found to resemble ordinary chondritic meteorites in spectral properties (it is similar to LL6 chondrites in pyroxene/olivine content). The first two measured Trojan asteroids show unusual spectra *not* compatible with carbonaceous chondrites or other known meteorites. The spectrum of Mars-crosser 887 Alinda is compatible with unequilibrated chondrites. Most fainter asteroids (especially those in the outer half of the belt) have flat spectra indicating probable carbonaceous composition. Compositional heterogeneity of Hirayama families is common among the 16 families studied to date. But individual asteroids seem to have remarkably uniform surface compositions, indicated by the usual lack of spectral changes with rotation. Spectra of a preliminary sample of proposed meteorite source-bodies are consistent with derivation of meteorites by proposed mechanics, but further observations are needed. (auth)

15384 ^{87}Rb-^{86}Sr AGE OF ROCKS FROM THE APOLLO 15 LANDING SITE AND SIGNIFICANCE OF INTERNAL ISOCHRONS. Birck, J. L.; Fourcade, S.; Allegre, C. J. (Paris-6 Univ., 75 (France). Inst. de Physique du Globe). Earth Planet. Sci. Lett.; 26: No. 1, 29-35(May 1975).

Internal isochrons for two Apollo 15 rocks give an age of (3.34 ± 0.09) and (3.46 ± 0.04) × 10^9 years with an identical $^{87}Sr/^{86}Sr$ initial ratio of 0.69928. Considering the possibility for the line obtained in a $^{87}Sr/^{86}Sr$, $^{87}Rb/^{86}Sr$ diagram to be a mixing line, the significance of these results are discussed. (auth)

15385 HELIUM ISOTOPES IN THE EARTH'S INTERIOR AND IN THE ATMOSPHERE: A DEGASSING MODEL OF THE EARTH. Tolstikhin, I. N. (Institute of Precambrian Geology, Academy of Sciences, Leningrad, USSR). Earth Planet. Sci. Lett.; 26: No. 1, 88-96(May 1975).

A first order degassing model was applied to describe the evolution of helium content and isotope composition in the earth and in the atmosphere. The main events described by the model are: (1) the earth-trapped primordial rare gases at the moment of its accretion; (2) later, the solid earth lost primordial and radiogenic rare gases, and (3) they were accumulated in the atmosphere; (4) in addition, ^3He was formed in the atmosphere due to cosmic irradiation, accretion from solar wind, etc.; (5) ^3He and ^4He dissipated into space at different loss rates. Study of this model confirms the concept that some of primordial helium is retained in the interior of the earth; terrestrial helium ($^3He/^4He = 2 \times 10^{-5}$) was most probably formed as a mixture of primordial ($^3He/^4He = 3 \times 10^{-4}$) and radiogenic ($^3He/^4He = 3 \times 10^{-8}$) helium. For achondritic concentrations of heavy radioactive elements (U = 2.25 × 10^{-8} g/g) the calculated ^4He flux from the earth is equal to 5.7 × 10^6 at cm^{-2} sec^{-1}. The corresponding ^3He flux is about 114 at cm^{-2} sec^{-1}. In discussing the aeronomic problem of helium it is necessary to take into account that the earth is the main source of the light helium isotope. (auth)

15386 DEVELOPMENT OF A COMET AS IT PURSUES ITS ORBIT. Lyttleton, R. A. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy). Astrophys. Space Sci.; 34: No. 2, 491-510(May 1975).

The properties of cometary dust-swarms in almost parabolic long-period orbits are examined. That the quiescent structure of comets consists of a vast widely spaced swarm of minute dust-particles receives circumstantial support from the highly varied and peculiar properties long since recorded for numerous comets. These properties exhibit such erratic diversity as to make clear that only a theory involving considerable range of essential parameters can be capable of accounting for them adequately. (auth)

15387 ON THE 1968 OCCULTATION OF BD-17°4388 BY NEPTUNE. Wallace, L. (Kitt Peak National Observatory). Astrophys. J. 197: No. 1, 257-261 (1 Apr 1975).

The difficulties involved in extracting temperature information from occultation light curves are emphasized. The least uncertain parameter, the scale height defining the gross variation of refractivity, is determined to be about 49 km with an uncertainty of at least 2 km. Detailed temperature profiles derived from the light curves exhibit considerably greater uncertainty. (auth)

15388 Na-D LINE EMISSION FROM ROCK SPECIMENS BY PROTON BOMBARDMENT: IMPLICATIONS FOR EMISSIONS FROM JUPITER'S SATELLITE Io. Nash, D.B.; Matson, D.L.; Johnson, T.V.; Fanale, F.P. (Space Sciences Division, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Geophys. Res. 80: No. 14, 1875-1879 (10 May 1975).

Laboratory experiments show that substantial Na-D line emission is produced by 3— to 5—keV proton bombardment of silicate and halite rock powders. Emission intensity and energy efficiency are directly proportional to sodium content and are total dose, dose rate, and proton energy dependent. Highest energy efficiencies were encountered with halite (NaCl) and are of the order of 10^6 at proton fluxes of $\sim 10^{13}$ cm^{-2} s^{-1}. Na-D photon emission is interpreted as emanating predominantly from sputtered sodium slightly above the target surfaces. Laboratory Na-D intensities from halite fall within the range of Na-D emission intensities recently discovered in the spectrum of the Jovian satellite Io but were achieved with higher flux and power densities than those expected for Io. The Na-D line emission directly excited during surface sputtering by Jovian magnetospheric protons may possibly be an observable component in the Io emission. In any case, sputtering of sodium-rich surface material is a mechanism which can inject sodium (and other material) into the 'atmosphere' and space about Io. (auth)

15389 ROTATIONAL CHARACTERISTICS OF THE EARTH DURING THE PERIOD FROM 1956 TO 1970 AND THEIR RELATION TO GEOMAGNETISM AND THE SUNSPOTS. Krueger, H. (Zentralinstitut fuer Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 83: No. 4, 286-292(1974). (In German).

Observations of star occultations by the moon made in Potsdam, German Democratic Republic, are discussed along with questions regarding the observational correction system used. The cyclic characteristics of the total intensity of the geomagnetic field and of the relative sunspot numbers are considered and an investigation is conducted concerning the relation of the rotational behavior of the earth to the total geomagnetic field intensity and the sunspots. (Int. Aerosp. Abstr.) (auth)

15390 GEODETIC ASPECTS OF LASER DISTANCE MEASUREMENTS TO THE MOON AND RADIO-INTERFERENCE MEASUREMENTS TO QUASARS. Arnold, K. (Zentralinstitut fuer Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 83: No. 4, 249-269(1974).

An investigation is conducted regarding the distance between a terrestrial observing station and a laser reflector on the moon, taking into account the functional relations between this distance and various parameters. Attention is given to the coordinates of the station, the parameters of polar motion, the deceleration of the earth's rotation, and the space coordinates of the reflector. The feasibility of a determination of the individual parameter values on the basis of the distance measurements is studied. (Int. Aerosp. Abstr.) (auth)

PHYSICS (ATMOSPHERIC)

15391 (AD/A-003399) AFCRL FISCAL YEAR 1975, AIR FORCE TECHNICAL OBJECTIVES DOCUMENT. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 1 Nov 1974. 88p. (AFCRL-SR-184; AFCRL-TR-74-0581). NTIS $4.25.

The report describes the eight technical planning objectives in environmental and electromagnetic technologies. The environmental areas of concern include meteorology, infrared/optical physics, aeronomy and ionospheric physics, solar and space physics, and the earth sciences. The electromagnetic technologies cover microwave propagation, equipment and techniques, and electronic and electro-optic materials and devices. (GRA)

Auroral and Ionospheric Phenomena

Refer also to abstracts 15083, 15086, 15237, and 15267.

15392 (AD-784864) SOLAR AND GEOPHYSICAL RADIO OBSERVATIONS. I. Polarization Observations of Solar Active Regions. 2. Suggestive Evidence of Tilted Ionospheric Troughs. Papagiannis, M. D. (Boston Univ., Mass. (USA)). Dec 1973. 37p. (CONF-731227-; CONF-740435; SER-II-NO-58). NTIS $3.25.

From The American Astronomical Society meeting; Tucson, Arizona, USA (Dec 1973).

Disturbed conditions of the terrestrial atmosphere, ionosphere, and magnetosphere, and their dependence on solar activity are studied. Report covers polarization observations of solar active regions and total electron content studies with emphasis on ionospheric trough effects. Extensive observations of left and right circular polarized emission at 7.875 GHz from solar active regions were made. (GRA)

15393 (AD-786415) SPACE FORECAST TECHNIQUES. Final Report, 1 July 1972–30 June 1974. Moschandreas, D. J.; Enger, I.; Hwang, P. H. J. (Geomet, Inc., Rockville, Md. (USA)). 28 Jun 1974. Contract F19628-73-C-0015. 94p. (GEOMET-MF-329; AFCRL-TR-74-0299). NTIS $4.75.

The regression estimation of event probabilities (REEP) technique was used for predicting the duration of the largest short-wave fadeout expected to occur tomorrow from information available today. A computer program was developed and adapted to the Air Force global weather central computers to estimate (A_p) values, in real-time, rapidly from observations made at four stations, given that the observations are missing sporadically and randomly. Feasibility of using REEP to investigate the F0F2 behavior during a geomagnetic storm was studied. Regression equations were developed for predicting the 2-12A x-ray flux tomorrow given a series of relevant parameters today. (GRA)

15394 (AD/A-003386) D- AND E-REGIONS. Swider, W. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 12 Sep 1974. 22p. (AFCRL-ERP-488; AFCRL-TR-74-0493). NTIS $3.25.

The chemistry of the E-region is fairly well understood and even many of the dynamical complications of this region have been successfully modeled on individual bases. Some of the major remaining problems of this region are discussed, in particular the nitric oxide concentration, a gas affecting the ratio of the two major e-region ions, 02(+) and NO(+). The d-region is much simpler than the e-region from a dynamical point of view but extremely much more complex from a chemical standpoint. Recent results from a study of the d-region under bombardment by solar protons is emphasized. (GRA)

15395 (EGG-1183-1663) BARIUM PLASMA INJECTION AT L APPROX. equals 6 CONDUCTED DURING SKYLAB III. Eastman, T. E.; Broste, W. B.; Pentecost, M. L.; Wright, D.; Bottoms, P. J.; Peck, H. M. (EG and G, Inc., Los Alamos, N. Mex. (USA)). 1975. Contract AT(29-1)-1183. 13p. (CONF-750619-2). Dep. NTIS $4.00.

From 56th annual meeting of the American Geophysical Union; Washington, District of Columbia, USA (16 Jun 1975).

The SKYLAB barium events are part of a continuing series of high altitude rocket experiments using shaped charge barium payloads. The barium experiments have three objectives: (1) to evaluate payload performance, (2) to determine the geomagnetic field line configuration and (3) to study the effects of plasma conductivity and geomagnetic activity on the motion of barium plasma. The total ion inventory and ion velocity distribution is measured to evaluate payload performance. A sequence of triangulated points on the barium cloud is compared with currently available field line models to determine the field line configuration. The effects of geomagnetic activity or plasma conductivity are studied by studying the morphology of the cloud. Results are given. (10 diagrams) (BJG)

15396 (EGG-1183-1664) DOPPLER SHIFT CORRECTIONS IN THE CALCULATION OF BARIUM CLOUD ION INVENTORY. Eastman, T.; Broste, W.; Wright, D. (EG and G, Inc., Los Alamos, N. Mex. (USA)). 1975. Contract AT(29-1)-1183. 10p. (CONF-750619-1). Dep. NTIS $4.00.

From 56th annual meeting of the American Geophysical Union; Washington, District of Columbia, USA (16 Jun 1975).

A solution is offered to the problem posed by the fact that total ion yields were originally estimated to be larger than the maximum expected in barium cloud ion inventory. Since shaped charge releases result in a velocity distribution with velocities ranging up to over 15 km/sec, the absorption wavelength for the barium ions is Doppler shifted in their own rest frame resulting in significant changes in input solar flux. As a result, the solar input flux is not constant in time for a given barium ion, and the observed optical power is a function of both ion inventory and ion velocity. (BJG)

15397 (PB-237645) DENSITY VARIATIONS OF THE UPPER ATMOSPHERE BELOW 200 KM FROM ANALYSES OF HIGH ECCENTRICITY SATELLITE ORBIT DECAYS. Bowman, B. R. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). Dec 1973. 135p. (HIG-73-17). NTIS $5.75.

Upper atmospheric density variations in the 100- to 200-km altitude region are determined from two satellite geodetic analyses of the decay of high eccentricity orbits with low perigee heights. Variations at the 200-km height are examined for a continuous two-year period using the orbit of satellite 1967-31A, while those in the 120- to 150-km region are examined for more than eight months using the orbit of the 4th molniya 1 upper stage rocket body, 1966-92D. A semi-analytical, luni-solar gravitational theory is developed to predict third-body orbit perturbations of separating the atmospheric drag from the non-solar gravitational theory is developed to predict third-body orbit perturbations for separating the atmospheric drag from the non-drag effects. Good comparisons are obtained with 1000- to 2000-day predictions and the observed orbital element changes of several high eccentricity orbits. (auth)

15398 (WRE-TN-1241(WR and D)) EMPIRICAL MODEL OF GLOBAL SPREAD-F OCCURRENCE. Singleton, D. G. (Weapons Research Establishment, Salisbury (Australia)). Sep 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

A method of combining models of ionospheric F-layer peak electron density and irregularity incremental electron density into a model of the occurrence probability of the frequency-spreading component of spread-F is presented. The predictions of the model are compared with spread-F occurrence data obtained under sunspot maximum conditions. Good agreement is obtained for latitudes less than 70° geomagnetic. At higher latitudes, the inclusion of a "blackout factor" in the model allows it to accurately represent the data and, in so doing, resolves an apparent discrepancy in the occurrence statistics at high latitudes. The blackout factor is ascribed to the effect of polar blackout on the spread-F statistics and/or the lack of a definitive incremental electron density model for irregularities at polar latitudes. Ways of isolating these effects and assessing their relative importance in the blackout factor are discussed. The model, besides providing estimates of spread-F occurrence on a worldwide basis, which will be of value in the engineering of HF and VHF communications, also furnishes a means of further checking the irregularity incremental electron density model on which it is based. (auth)

15399 INVESTIGATION OF A DRIFTING PLASMA CONTAINING NEGATIVE IONS BY CYLINDRICAL LANGMUIR PROBE ION MASS SPECTROMETER. Ragab, F. M. (Univ. of Tripoli, Libya). IEEE Trans. Plasma Sci.; PS-3: No. 1, 18-22(Mar 1975).

Cylindrical Langmuir probes were used as diagnostic techniques for the drifting plasma. A cylindrical probe of suitable radius in relation to lambda and lambda$_0$ was chosen. The probe was swept by a composite waveform which contained a sawtooth sweep and two audio-frequency signals. The experiment was flown on board a stabilized rocket "Centaure" at high latitudes at Norway. (auth)

15400 EFFECT OF EAST-WEST ASYMMETRY OF COSMIC RAYS ON THE RATE OF FORMATION OF ELECTRONS IN THE COSMIC LAYERS. Velinov, P. I. (Inst. of Geophysics, Sofia).

Compt. Rend. Acad. Bulg. Sci.; 27: No. 9, 1195-1197(1974). (In Russian).

The effect of the east-west asymmetry (azimuthal effect) of cosmic radiation was examined in the first approximation and an evaluation was made of its existence in order to determine the ionization states of the cosmic layers in the lower ionosphere. (JSR)

15401 DAILY AND SEASONAL VARIATIONS OF DIFFERENCES BETWEEN MEDIAN AND MEAN VALUES OF CRITICAL FREQUENCIES IN F REGION. Lilov, A.; Serafimov, K. B. (Central Lab. for Space Research, Sofia). Compt. Rend. Acad. Bulg. Sci.; 28: No. 1, 37-39(1975).

Data are used from ionospheric stations in the medium-latitude geomagnetic zone for a direct analysis of the difference between the median and mean value of critical frequencies in the F region. Certain regularities in the daily and seasonal frequency differences can be established. The greatest frequency differences between the median and the mean valves are observed during the periods around the equinox. Results indicate that in principle, use can be made of the regularity valid for the normal Gauss distribution of the critical frequencies. (BJG)

15402 DISTRIBUTION OF DIFFERENT TYPES OF WHISTLERS AT GEOMAGNETIC LATITUDES BELOW 40°N. Ralchovski, T. M. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 12, 1651-1653(1974).

In the course of a 4-year observation period from Sofia observatory (geomagnetic latitude: 37.7°N), so-called normally dispersed whistlers have been established for which the value of the experimentally measured dispersion lies in the range of 40-70 $sec^{\frac{1}{2}}$. From the review made of the latitude distribution of the types of whistlers it can be concluded that a ducting propagation of the low-frequency wave is observed at L-values exceeding 1.7. (BJG)

15403 IONOSPHERIC EFFECTS OF X-RAY SOURCE SCORPIUS XR-1. Poppoff, I. G.; Whitten, R. C.; Willoughby, D. S. (National Aeronautics and Space Administration, Moffett Field, CA). J. Atmos. Terr. Phys.; 37: No. 5, 835-840(May 1975).

A comment is made regarding the problem of matching ionospheric theory with reported x-ray star effects on terrestrial radio propagation. It is concluded that the observations are not readily explained by the x-ray hypothesis. (auth)

15404 DAYGLOW OF THE INFRARED ATMOSPHERIC BAND SYSTEM OF O_2 DURING A TOTAL ECLIPSE OF THE SUN. Wraight, P. C.; Gadsden, M. (Univ. of Aberdeen, Eng.). J. Atmos. Terr. Phys.; 37: No. 5, 717-730(May 1975).

Observations are reported of the radiation from $a^1\Delta_g$ oxygen at 1.27 and 1.58μ. The observations were made using a tilting filter spectrophotometer in Concorde 001, flying at heights up to 17 km. The emissions were observed at several zenith distances, geographic latitudes and times of day, and, in particular, during the eclipse of 30 June 1973 over West and Central Africa. Results are presented concerning the normal dayglow, and also the variation of radiance during the eclipse; and the observations are compared with the theory of $^1\Delta_g$ oxygen production and quenching. (auth)

15405 EFFECTIVE RECOMBINATION COEFFICIENT MEASURED IN THE AURORAL E-REGION DURING A SUDDEN COMMENCEMENT ELECTRON PRECIPITATION EVENT. Brekke, A. (Univ. of California, La Jolla, San Diego). J. Atmos. Terr. Phys.; 37: No. 5, 825-833(May 1975).

Incoherent scatter radar observations are utilized to derive the effective recombination coefficient and the ion production rate in the auroral E-region during a sudden commencement precipitation event. The recombination coefficient is found to be $(1.1 \pm 0.3) \times 10^{-7}$ cm^3 sec^{-1} in good agreement with present laboratory measurements of the dissociative recombination coefficient of O_2^+ for an electron temperature close to 500 K. The ion production rate associated with the SC is found to be at least 4.5×10^4 el cm^{-3} sec^{-1} at 110 km, this corresponds to an enhancement above the background ionization by more than a factor of 10. The background ionization is also larger than expected from solar EUV radiation due to ionization associated with a PCA event present. (auth)

15406 ELECTRON PRODUCTION IN THE LOWER IONOSPHERE BY A DIFFUSE GALACTIC X-RAY BACKGROUND. Gagliardini, D. A.; Karszenbaum, H. (Univ. Nacional de La Plata). J. Atmos. Terr. Phys.; 37: No. 5, 845-849(May 1975).

The electron production rates in the lower ionosphere, due to galactic x-rays, are computed. It is shown that the contribution of photons of energies greater than 10 keV is relevant below 80 km. A nonconstant photoionization yield is introduced in the ionization rate calculations, proving that the constant value given previously underestimates the value of the total ion production. Using the spectrum considered more adequate, it is shown that at night the galactic x-ray contribution is not significant compared with the rate of ionization due to cosmic rays and scattered Lyman-α radiation. (auth)

15407 OBSERVATIONS OF ANGULAR DISTRIBUTIONS OF LOW ENERGY ELECTRON INTENSITIES OVER THE AURORAL ZONES WITH ARIEL 4. Craven, J. D.; Frank, L. A. (Univ. of Iowa, Iowa City). Proc. R. Soc. (London), Ser. A; 343: No. 1633, 167-188(29 Apr 1975).

Comprehensive measurements of the angular distributions of low energy electron intensities were gained with a pair of electrostatic analyzers, carried on the low altitude satellite Ariel 4. Initial observations of the angular distributions of electron intensities within the energy range 244 eV to 10.8 keV at an altitude of approximately 570 km over the local-evening sector of the auroral zone are summarized. Two readily distinguishable zones of electron intensities were encountered—the low altitude signature of plasma sheet electron intensities (equatorward of the trapping boundary for electrons E > 40 keV) and the more intense, more structured region of inverted V events lying poleward of this trapping boundary. (auth)

15408 TOPSIDE IONOSPHERE ELECTRON DENSITY MEASUREMENTS ON ARIEL 4. Goodall, C. V.; Hopkins, H. D.; Tulunay, Y. K.; D'Arcy, R. J. (Univ. of Birmingham, Eng.). Proc. R. Soc. (London), Ser. A; 343: No. 1633, 189-206(29 Apr 1975).

The accuracy and validity of the electron density measurements are discussed in terms of inherent system errors and those arising from satellite spin modulation effects. Comparative measurements with other independent techniques support the ± 5% error figure quoted for the accuracy of relative electron density measurements and suggest that overall agreement to within individual experimental errors would be achieved for measurements of absolute electron density if the present values were about 10% greater. Synoptic studies of the longitudinal variation of the equatorial anomaly confirm the frequency of occurrence to be greater in the Asian sector and observations of the development and decay suggest that for the Ariel 4 epoch ($z \approx 70$) the behavior is more appropriate to periods of maximum, rather than minimum, solar activity. Studies in a single, well defined magnetic storm showed a marked enhancement in the anomaly at the satellite altitude during the main phase followed by a sudden depletion in the early recovery phase. Improved selection criteria are described for the computer selection of mid-latitude troughs and examples of troughs thus selected are presented. Studies of the winter high latitude ionosphere in geomagnetically quiet periods indicate significant longitudinal variations and solar-geomagnetic control. (auth)

15409 OBSERVATIONS OF RADIO FREQUENCY NOISE FROM ARIEL 4. Walsh, D. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.); Hayes, A. P.; Harrison, V. A. W. Proc. R. Soc. (London), Ser. A; 343: No. 1633, 227-240(29 Apr 1975).

Radio frequency observations of noise in the upper ionosphere were made with a 12 m electric dipole and a narrow-bend receiver which either swept from 0.25 to 4.0 MHz every 16 s or operated at a fixed frequency of 2 MHz. Several distinct types of noise were observed. One is similar to that previously studied by a number of space vehicles close to the electron gyro- and plasma frequencies. Evidence is presented that simple theories based on the generation of electromagnetic waves by Cherenkov radiation in a cold plasma with subsequent propagation are inadequate to account for this noise. Two other kinds of noise observed may be locally generated; one at least, which has an impulsive character, by an interaction between the satellite and the plasma. As the satellite crosses the auroral regions, an interesting series of apparently related phenomena is observed when comparison is made with data from other experiments on the satellite. This is most clearly defined in the 'daytime cusp' region. An enhancement of the radio noise is accompanied by intense bursts of electrons in the moderate energy range at and below 1 keV, typical of this region, and by a sharp dip in the ambient electron density. The latter is presumably the daytime extension of the ionospheric "trough". (auth)

15410 CERENKOV RELATIONS BETWEEN rf NOISE AND ENERGETIC PARTICLES ON ARIEL 4. Smith, P. A. (Science Research Council, Slough, Eng.). Proc. R. Soc. (London), Ser. A; 343: No. 1633, 241-255(29 Apr 1975).

Intense noise bands were observed by the Ariel 4 r.f. experiment operating at frequencies between 0.25 and 4 MHz in the topside ionosphere. An examination of the frequency coverage of the bands shows that they are mainly confined to those domains which correspond to a high refractive index of the medium. The O mode whistler band appears in a range which extends from the lowest frequency of measurement mainly up to the gyro-

frequency. The X mode upper-hybrid band extends from a lower limit which depends on the local plasma frequency, to a frequency slightly beyond the upper-hybrid resonance frequency. Both bands attain their highest levels in the auroral zone at latitudes where electrons in the hundreds of eV range are most numerous. On the dayside the latitude of these highest levels depends on the K_p value. By carrying out a calculation of the Cherenkov radiation from the energetic electrons present, a determination of the frequency spectrum of the whistler noise at m.f. is made and found to fit well with the measured data. (auth)

15411 IONOSPHERIC DIRECT MEASUREMENT TECHNIQUES. Bauer, S. J.; Nagy, A. F. (Goddard Space Flight Center, Greenbelt, MD). Proc. IEEE (Inst. Elec. Electron. Eng.); 63: No. 2, 230-249(Feb 1975).

A summary is given of the direct in situ measurement techniques which are currently in use to measure the important ionospheric parameters above about 100 km, where the mean free path of the neutral and charged particles is greater than the characteristic dimension of the instruments. Direct in situ instrumentation is defined as an experiment which measures the parameters in the vicinity of the vehicle carrying the instrument. (177 refs.) (auth)

15412 EQUATORIAL SPREAD F: LOW FREQUENCY MODES IN A COLLISIONAL PLASMA. Hudson, M. K. Los Angeles; Univ. of California (1974). 226p. University Microfilms Order No. 74-29,262.

Thesis (Ph. D.).

A comprehensive linear plasma instability theory for the density gradient-dependent modes of a collisional plasma to suit the parameters of the nighttime equatorial F region has been developed. An electromagnetic dispersion relation for the drift, entropy and interchange modes from two-fluid theory has been obtained. It has been found that the asymptotic behavior at long parallel wavelengths is isothermal in a partially ionized plasma and adiabatic in the fully ionized limit. Below the F peak both the drift and Rayleigh-Taylor modes contribute to the total spread F spectrum. (BJG)

15413 SOME REMARKS ON THE EQUATORIAL SPORADIC E LAYER AT KODAIKANAL. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sect. A; 80: No. 6, 257-267(Dec 1974).

It is shown that the sporadic E layer at an equatorial station is not always of the commonly known equatorial (q) type Es. Broadly there occur two types of Es at a station near the magnetic equator, viz., diffuse q type and multiple or blanketing (b) type. The latter may be of diffuse type or of thin layer type. The Es-b is due to highly dense cloud of ions which are localized, whereas Es-q occurs over an extended area at any time. The effect of counter-electrojet is seen on both the types of Es layers. The disappearance of sporadic E during counter-electrojet is valid for only the q type of Es, but sometimes Es-b may occur during periods of very weak or reversed electrojet. It is suggested that published equatorial Es data should be used with caution unless the type of Es is also indicated. The plausible causes of the sudden disappearance of Es-q on some occasions and the appearance of Es-b during others are suggested. (auth)

15414 THE *K* SPECTRUM OF IONOSPHERIC IRREGULARITIES. D'Angelo, N. (Danish Space Research Institute, Lyngby, Denmark); Pécseli, H.L.; Petersen, P.I. J. Geophys. Res. 80: No. 13, 1854-1855 (1 May 1975).

Laboratory measurements in a cesium plasma device indicate that the wave number (power) spectrum of irregularities produced by the Farley instability is of the type $P(K) \propto K^{-\beta}$, where $\beta \simeq 3.5-3.8$. (auth)

15415 COMPARISON OF HIGH-LATITUDE AND MID-LATITUDE IONOSPHERIC ELECTRIC FIELDS. Carpenter, L.A.; Kirchhoff, V.W.J.H. (Ionosphere Research Laboratory, Pennsylvania State University, University Park, Pennsylvania 16802). J. Geophys. Res. 80: No. 13, 1810-1814 (1 May 1975).

Simultaneous measurements of the F region electric field by the incoherent scatter technique have been made at Chatanika, Alaska (65.1°N, 147.5°W), and Millstone Hill, Massachusetts (42.6°N, 71.5°W), on July 18–19 and August 7–8, 1973. Good correlation was observed in the time variation of the perpendicular electric field at the two stations. Magnetic conditions for these days were relatively quiet with some variations evident from the high-latitude magnetograms and the Chatanika radar, but no distinct effect appeared on the mid-latitude magnetograms. Since magnetospheric electric fields are thought to be the source of high-latitude electric fields such as those observed at Chatanika, the good correlation in the perpendicular electric field for the two stations indicates that the magnetospheric originated electric fields have an appreciable effect down to at least L=3.2. (auth)

15416 SELF-FOCUSING OF INTENSE RADIO WAVES IN THE IONOSPHERE. Tomljanovich, N.M. (The MITRE Corporation, Bedford, Massachusetts 01730). Phys. Fluids 18: No. 6, 741-747 (June 1975).

Nonstationary self-focusing of electromagnetic waves under the action of Ohmic heating is investigated for anisotropic inhomogeneous plasmas. This mechanism may be responsible for field-aligned structure generation by intense radio waves in the ionosphere, which, in turn, gives rise to observed artificial spread-*F* ionospheric striations and high-frequency scattering. For a vertical geometry, a linearized analysis is given providing a field-aligned filamentation rate as a function of perturbation transverse wavelength, incident power, and plasma parameters. For typical ionospheric parameters and incident flux of 50 $\mu W/m^2$, exponentiation times of the order of 5 sec are obtained for transverse wavelengths of the order of a kilometer. (auth)

15417 IONOSPHERIC REFLECTION OF DOWNCOMING WHISTLER WAVES INCLUDING THE GROUND EFFECT. Hayakawa, M. (Nagoya Univ., Aichi, Japan). Pure Appl. Goephys.; 112: No. 3, 513-517(1974).

The reflection mechanism of downcoming whistler waves is discussed with a special view to its dependence on dip angle of the earth's magnetic field. The reflection coefficients of downcoming whistler waves are compared for a lower ionospheric model with and without the ground effect taken into account. It is found that the reflection from the earth's surface contributes significantly to the reflection coefficients at high latitudes. (Int. Aerosp. Abstr.) (auth)

15418 CONSTITUTIVE RELATIONS IN IONOSPHERIC DYNAMICS. Moehlmann, D. (Zentral institut fuer Solar-Terrestrische Physik, Berlin). Gerlands Beitr. Geophys.; 83: No. 4, 270-274(1974).

A three-fluids model of the ionospheric plasma has been used to derive a generalized version of Ohm's law, taking into account the collisions between electrons and ions. Within the same approximation a new linear local law has been derived, describing locally the force density acting on the neutral ionospheric gas due to collisions of ions and electrons with the neutrals. Using this law the ionospheric neutral wind fields can be computed without solving simultaneously the equations of motion for the electron and ion gases. Nevertheless, the effects of these gases on the motions of the neutrals can be taken into account exactly. (Int. Aerosp. Abstr.)

15419 VOZDEISTVIE KOSMICHESKIKH LUCHEI NA IONOSFERU I RASPROSTRANENIE RADIOVOLN. (Cosmic-Ray Influence on the Ionosphere and on Radio-Wave Propagation). Velinov, P.; Nestorov, G.; Dorman, L. Sofia; Izdatel'stvo Bolgarskoi Akademii Nauk (1974). 311p.

Investigations made on the influence of cosmic rays of galactic and solar origin and of the corpuscular fluxes on the lower and middle ionosphere are presented. The methods of analysing the interactions between cosmic rays and the upper atmosphere, described in the monograph, make it possible to pass from measurable ionospheric parameters to numerical evaluations of a number of quantities in the earth's environment, based on the high sensitivity of the ionosphere to space phenomena. The analysis of variations and disturbances of solar and galactic origin allow numerical determination of certain basic parameters of the lower ionosphere and the evaluation of their influence on the propagation of radio waves. (GHT)

15420 DETERMINATION OF foF2 AND hmF2 FROM SATELLITE-BORNE PROBE DATA. King, J. W. (Science Research Council, Slough, Eng.). Telecommun. J.; 40: 364-368(Jul 1973).

The results of theoretical calculations for a point 50 S, 60 W at sunspot maximum equinox conditions are used to investigate the relationship between foF2 and the plasma frequency, fs, measured by means of a satellite. The manner in which this relationship varies with satellite height, local time, and electron temperature at the height of the satellite is described. It is demonstrated that, at noon, different electron temperatures within the range observed on different days result in values of foF2/fs which differ by 70%. The results of the theoretical calculations are shown to be in satisfactory agreement with the observed behavior determined by means of topside sounder electron distributions and also Ariel-3 electron probe data. It is concluded that the theory of the F2-layer has now reached a stage such that theoretical curves, of which examples are given, may be used to derive values of foF2 from satellite observations of fs and electron temperature over certain regions of the earth. (auth)

Effects of Nuclear Detonations

Refer also to abstract 15421.

Magnetospheric Phenomena

Refer also to abstracts 15086, 15392, 15395, and 15396.

15421 (AD-738841) TRAPPED RADIATION HANDBOOK. Report for January 1968–June 1970. Cladis, J. B.; Davidson, G. T.; Newkirk, L. L. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA)). Dec 1971. Contract DA-49-146-XZ-570. 733p. (LMSC-6-95-95-3; DNA-2524H). NTIS $9.00.

The Trapped Radiation Handbook provides information and design data for scientists and engineers engaged in the design of spacecraft systems that must operate in the trapped radiation environment. These subjects are discussed: the magnetosphere; features and mathematical models of the earth's magnetic field; the motion of charged particles in the field; the properties of the particles in the natural radiation belts; source and loss mechanisms; the artificial radiation belts that have resulted from tests of nuclear devices conducted at high altitudes; the phenomenology of nuclear detonations and beta injection processes; the effects of trapped particles–both natural and fission betas–on materials and devices: The irradiation of circular orbit satellites by trapped particles of (1) the natural environment, (2) environments produced by weapon tests at various L-values, and (3) an estimated wartime environment; the synchrotron radiation emitted by the trapped electrons; and the vulnerability of operational systems in the environments (1), (2), and (3) mentioned previously. (auth)

15422 (AD/A-003402) EFFECT OF DRIFT-RESONANCE BROADENING ON RADIAL DIFFUSION IN THE MAGNETOSPHERE. Schulz, M. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Nov 1974. 13p. (SAMSO-TR-74-245). NTIS $3.25.

The purpose of this work is to address a conceptual problem inherent in the theory of magnetospheric radial diffusion. In the usual formulation (e.g., Falthammar, 1968), one considers the radiation belts to be immersed in randomly fluctuating electrostatic and electromagnetic fields (superimposed on the earth's time-averaged B field). The fluctuations are considered adiabatic on the gyration and bounce time scales, but describable by smooth spectra that are nonvanishing at the particle drift frequency $(\omega_3)/2$ Pi. The radial-diffusion coefficient (D_{LL}) is then proportional to the spectral density at $\omega = \omega_3$. (auth)

15423 PARTICLE DIFFUSION IN THE RADIATION BELTS. Schulz, M.; Lanzerotti, L. J. Physics and Chemistry in Space, Volume 7. New York; Springer-Verlag (1974). 223p. $32.00.

Five chapters in addition to a summary and table of frequently used symbols comprise this text. The first chapter is devoted to the adaibatic motion of charged particles as applied to simple models of the earth's magnetosphere. The second and third chapters cover the theory of selected dynamical processes that violate adiabatic invariants and consequently lead to particle diffusion. The fourth and fifth chapters describe the interpretation and analysis of observational data having quantitative significance in terms of radial and pitch-angle diffusion. The summary gives the present state of knowledge in the field. (BJG)

15424 ELECTROSTATIC AND ELECTROMAGNETIC TURBULENCE ASSOCIATED WITH THE EARTH'S BOW SHOCK. Rodriguez, P. Iowa City, IA; Univ. of Iowa (1974). 141p. University Microfilms Order No. 75-1249.

Thesis (Ph.D.).

The electric and magnetic field spectral densities of plasma waves in the earth's bow shock have been measured in the frequency range 20 Hz to 200 kHz using two 16-channel spectrum analyzers on the IMP-6 spacecraft. Electrostatic noise with a spectrum similar to the turbulence in the shock, but with lower intensities, is observed throughout the magnetosheath region, downstream of the shock. The intensity of the electrostatic component of turbulence in the bow shock increases as the upstream electron to ion temperature ratio increases, and decreases as the upstream sound velocity increases; both of these variations for the electrostatic component are consistent with ion sound wave turbulence. (auth)

15425 MHD WAVE TRANSMISSION AND PRODUCTION NEAR THE MAGNETOPAUSE. Wolfe, A.; Kaufmann, R.L. (Department of Physics, University of New Hampshire, Durham, New Hampshire 03824). J. Geophys. Res. 80: No. 13, 1764-1775 (1 May 1975).

The magnetopause is assumed to be a stable, plane, tangential discontinuity so that we can calculate the amplitudes of waves that are transmitted through, reflected from, and produced at this interface. The calculations show that the ratio of magnetosphere to magnetosheath wave power spectral densities should depend most sensitively upon the ratios of field strengths and plasma densities and upon the magnetic field direction change at the magnetopause if all waves seen in the magnetosphere were transmitted through the interface. These calculations are compared with Explorer 12 measurements of waves with periods between 30 s and 2 min. The observations show that the source of most wave power seen in the magnetosheath near the earth-sun line lies in the magnetosheath or beyond. Transmission could account for a substantial fraction of the wave power seen in the magnetosphere in this subsolar region. Beyond about 35° from the earth-sun line, magnetosphere wave power levels are much higher than is predicted by transmission through a stable closed magnetopause. The observations are generally consistent with a Kelvin-Helmholtz instability model of wave production in this region well away from the subsolar point. (auth)

15426 INDUCTIVE ELECTRIC FIELD OF A TIME-DEPENDENT MAGNETOTAIL CURRENT. Murphy, C.H.; Wang, C.S.; Kim, J.S. (Department of Atmospheric Science, State University of New York at Albany, Albany, New York 12222). Geophys. Res. Lett. 2: No. 5, 165-168 (May 1975).

The inductive electric field produced by a time-dependent magnetotail current system is investigated using a simple model. The model current system used in these calculations is a 'theta' representation consisting of a flat sheet of current flowing westward to represent the neutral sheet and return currents flowing eastward on the boundary of the tail. Assuming realistic parameters for the dimensions and strength of the current system and a linear variation of the current during times of magnetic activity, it is found that the inductive electric field is predominantly in the east-west direction, and is fairly uniform over a large range of east-west and antisolar directions. An east-west inductive electric field of as much as 0.70 mv/m is produced during substorms by a time variation of the tail current which corresponds to a rate of change of the total magnetic field near the inner edge of the neutral sheet of about 10^{-2} γ/sec. (auth)

15427 A NEW PLASMA REGIME IN THE DISTANT GEOMAGNETIC TAIL. Hardy, D.A.; Hills, H.K.; Freeman, J.W. (Rice University, Houston, Texas 77001). Geophys. Res. Lett. 2: No. 5, 169-172 (May 1975).

The three Rice Suprathermal Ion Detector Experiments have detected an extensive region of low energy plasma flow antisunward along the ordered field lines in the lobes of the geomagnetic tail at lunar distances. This particle regime resembles the "boundary layer" and "plasma mantle" observed at smaller geocentric distances and an interior flow region parallel to the magnetopause in the dayside magnetosphere. It possesses plasma characteristics uniquely different from the plasma sheet and magnetosheath. Spatially the particle regime is found exterior to the plasma sheet across essentially the entire tail and adjacent to the magnetopause on both the dawn and dusk sides of the magnetosphere. The integral flux varies from 10^5 to 10^8 ions/cm^2 sec ster with the differential flux peak between 50 and 250 eV/q. Temperatures range from 4×10^4 to 5×10^5°K and number densities from .1 to 5/cm^3. (auth)

15428 ELECTROSTATIC ELECTRON-CYCLOTRON WAVES WITH AN ANTI-LOSS-CONE DISTRIBUTION FUNCTION. Nambu, M. (General Education Dept., Kyushu University, Ropponmatsu Fukuoka, 810, Japan); Watanabe, T. Geophys. Res. Lett. 2: No. 5, 176-178 (May 1975).

High-frequency electrostatic instabilities with an anti-loss-cone distribution are considered numerically. The new collective modes associated with the oscillation of the negative pressure particles appear slightly above the electron cyclotron frequency. (auth)

15429 SELF-CONSISTENT ROTATING MAGNETOSPHERE. Michel, F.C. (Department of Space Physics and Astronomy, Rice University). Astrophys. J. 197: No. 1, 193-197 (1 Apr 1975).

We show that, to a good approximation, the emission of particles from the poles of an axisymmetrically (dipole) magnetized rotating star consists of particles of one sign from essentially the entire magnetic polar region ("cap"). Particles of the opposite sign are emitted in a thin sheath ("auroral zone") at the perimeter of the polar cap. This flow pattern determines the torque on the star and the distribution of plasma and fields at large distances from the star. Thus the basic first-order axisymmetric rotator problem seems to be solved in the limit that the particle inertia is small. Specifically, the meridional (radial) and azimuthal magnetic fields at large distances from the star are distributed according to $B_m = f_0/[2r^2\cos^4(\theta/2)]$, $B_\phi = \omega f_0 \tan(\theta/2)/rc$, where f_0 is the total polar cap magnetic flux, ω is the angular frequency of rotation, r is the radial distance, and c is the velocity of light. These relations are valid only for colatitude (θ) less than 90°, the magnetic field being symmetric about the equatorial plane. The consequent field discontinuity (current sheet) in the equatorial plane is the extension of the auroral zone sheath. (auth)

15430 REMARKS ON THE DP2-CURRENT SYSTEM. Troshichev, O. A. (Leningrad State Univ.); Pudovkin, M. L.; Pegov, L. A.; Grafe, A. Gerlands Beitr. Geophys.; 83: No. 4, 275-285 (1974).

The separation of disturbances related to DR and DCF fields is discussed along with questions regarding a connection between the variations in the polar cap and in equatorial latitudes. The current systems of the DP2 variations are examined. The investigation shows that the choice of the level of reference determines the character of the equivalent current systems of the magnetic disturbances. The connection between the variations on the polar cap and in equatorial latitudes is found to be generally small. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

15431 SPACE-CHARGE LIMITS IN UNNEUTRALIZED RELATIVISTIC ELECTRON BEAMS. Read, M. E.; Nation, J. A. (Cornell Univ., Ithaca, NY). J. Plasma Phys.; 13: No. 1, 127-137 (Feb 1975).

Limiting currents in annular unneutralized relativistic electron beams are calculated and compared with experiment. The limiting factor for short beams is found to be the space-charge depression of the potential due to the unneutralized beam; in longer beams self-magnetic and electric fields impose a power limit. Typical beam impedances are found to be of the order of 15 Ω with a 350-keV beam. The role of shear in the axial velocity of the beam is discussed. (auth)

15432 SPUTTERING OF Nb AND Au BY (d,t) NEUTRONS. Harling, O.K.; Thomas, M.T.; Brodzinski, R.L.; Rancitelli, L.A. (Pacific Northwest Laboratory of the Battelle Memorial Institute, Richland, Washington 99352). Phys. Rev. Lett. 34: No. 21, 1340-1343 (26 May 1975).

Neutron-sputtering ratios are reported for (*d,t*) neutrons incident upon Nb and Au foils. The measured ratios are lower than most previous results. For annealed Au as well as for cold-worked Nb the best values for the sputtering ratios are in the range $S_n \lesssim (1.2-2.5) \times 10^{-5}$. These results are in good agreement with theoretical predictions. A careful search for neutron-induced micron-sized particles yielded negative results. (auth)

15433 COHERENT SYNCHROTON RADIATION FROM AN INTENSE RELATIVISTIC ELECTRON BEAM. Granatstein, V. L.; HERNDON, M.; Parker, R. K.; Sprangle, P. (Naval Research Lab., Washington, DC). IEEE J. Quant. Electron.; QE-10: No. 9, 651-654 (Sep 1974).

When an intense relativistic electron beam traversed a magnetic field of novel configuration, approximately 25 MW of narrow-band microwave power was emitted near the relativistic cyclotron frequency. The emitted waves are superluminous and propagate in a direction transverse to the applied magnetic field. The process is coherent, is driven by population inversion, and depends on the relativistic mass change. (auth)

15434 A SPUTTER PIG SOURCE (SPIGS) FOR NEGATIVE IONS. Smith, H. V. Jr.; Richards, H. T. (Wisconsin Univ., Madison (USA). Dept. of Physics). Nucl. Instrum. Methods; 125: No. 4, 497-502 (1 May 1975).

A radial-extraction Sputter PIG Source (SPIGS) is described which uses cathode sputtering by an argon plus cesium-vapor discharge to produce a wide variety of low-emittance negative-ion beams including metallic ions. With appropriate cathodes we find the following intensities: C^-, 3 μA; V^-, 0.1 μA; Ni^-, 4 μA; Cu^-, 8 μA; Nb^-, 0.2 μA; and Ta^-, 0.2 μA. With the appropriate discharge gas and low-sputtering cathodes SPIGS yields (without Cs addition) the usual negative ions available by dissociative attachment. A comparison between SPIGS and the surface-ionization sputter source UNIS shows SPIGS has better emittance but UNIS has longer operating life and higher beam intensities for light ions. (auth)

15435 OXIDIZED BN: AN EXCELLENT SOURCE MATERIAL FOR PRODUCING BORON ION BEAMS. De Keersmaecker, R. (Katholieke Universiteit Leuven, Departement Elektrotechniek, Kardinaal Mercierlaan 94, 3030 Heverlee, Belgium). Rev. Sci. Instrum. 46: No. 7, 921-922 (July 1975).

Several solid source loading materials for the production of a boron ion beam with a hot filament hollow cathode ion source are compared. As far as easy handling and large B^+ currents are concerned, oxidized boron nitride is shown to be an excellent choice. Currents of 80 μA $^{11}B^+$ are routinely obtained at the target from an oxidized BN source. (auth)

15436 ELECTRON IMPACT DESORPTION OF IONS FROM GAS-COVERED Si(111) SURFACES. Nishijima, M.; Fujiwara, K.; Murotani, T. (Central Research Laboratory, Mitsubishi Electric Corporation Ltd., Amagasaki, Hyogo, Japan). J. Appl. Phys. 46: No. 7, 3089-3091 (July 1975).

The electron impact desorption of ions was investigated using ~100-eV electrons from Si(111) surfaces covered with O_2, H_2O, CO, NO, HCl, H_2S, and NH_3. The observed ions are O^+ from Si-O_2 and Si-NO; H^+ and O^+ from Si-H_2O; and Cl^+ from Si-HCl. The ion yields, energy distributions of ions, and electron energy dependence of relative ion yields are reported. It is found that O_2, H_2O, and NO adsorb in a single state, respectively, and HCl adsorbs in at least two states. (auth)

15437 TOTAL BACKSCATTERING YIELDS OF 3-15-keV PROTONS FROM POLYCRYSTALLINE Nb. Verbeek, H. (Max-Planck-Institut für Plasmaphysik, Euratom Assocation, D-8046 Garching bei München, West Germany). J. Appl. Phys. 46: No. 7, 2981-2985 (July 1975).

Polycrystalline Nb samples were bombarded by 3–15-keV proton beams at normal incidence. The energy and angular distributions of backscattered positively and negatively charged particles were measured quantitatively. By means of the charged fractions measured previously, the energy and angular distributions of the total number of backscattered particles including the neutrals were obtained. Integration of the distributions over all energies and angles yield the total reflection coefficients. These are considerably lower than existing theoretical values. (auth)

15438 ION-OPTICAL SYSTEM FOR SHAPING HIGH-CURRENT ION BEAMS. Grishin, S.D.; Kuzovlev, V.F.; Orlov, R.V.; Ogorodnikov, S.N. Sov. Phys.—Tech. Phys. 19: No. 11, 1462-1464 (May 1975).

A description is given of an ion-optical system capable of shaping high-current hydrogen-ion beams (up to 100 A). Its characteristics are discussed. (auth)

15439 PRODUCTION OF LOW-ENERGY POLARIZED ELECTRONS. Ob"edkov, V.D. (Leningrad State University). JETP Lett. 21: No. 4, 98-99 (20 Feb 1975).

A new method is proposed for experimentally obtaining highly polarized low-energy electrons. The idea of the method is based on transferring the spin orientation of the atomic electron to the free electron by inelastic collision of the atoms, as a result of which the electron is detached. The particular processes considered in the article, as shown by estimates, can be used to obtain polarized electron beams of sufficiently large "brightness". (auth)

15440 INFLUENCE OF THE INITIAL ROW IMPACT PARAMETER AND THE ROW PERIODICITY ON AN ION'S DECHANNELLING. Pabst, H. J. (Univ. of Sussex, Eng.). Radiat. Eff.; 24: No. 4, 233-237 (Mar 1975).

Results are presented of computer simulations of light ion channelling in crystals which indicate four intervals of initial row impact parameters governing the dechannelling behaviour. The first (smallest impact parameters) causes 90% to 100% dechannelling in the collision with the first row, the second causes dechannelling in collisions with subsequent rows mainly due to the periodicity of the row potential, the third similarly due to subsequent collisions mainly due to thermal vibrations, and the fourth interval, associated with largest impact parameters, is the domain of electron multiple scattering. (auth)

Atomic and Molecular Properties

Refer also to abstracts 13823, 14915, 15139, 15140, 15489, 15497, 15503, and 15722.

15441 (AD/A-000263) ONR CONTRACT. Final Report, 1 March 1970–15 Nov 1974. Johnson, W. H. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 15 Nov 1974. Contract N000014-67-A-0113-0018. 10p. NTIS $3.25.

Work done in nuclear physics at the school of physics and astronomy during the period March 1, 1970 to November 15, 1974 is summarized. The work involved the employment of mass spectroscopic techniques to the measurement of various atomic and nuclear properties. A brief description of the program is given. A list of publications is given for work partially or totally supported under this contract. Also, a list of students who received support under the contract is presented together with the M. S. or Ph. D. thesis topics. Research performed under this contract was in three general areas of mass spectroscopy: determination of atomic masses and other nuclear properties, measurement of rare gases in meteorites and lunar samples, and instrument development. (GRA)

15442 EXTENDED ANALYSIS OF THE ARC SPECTRUM OF SCANDIUM. Neufeld, L.; Schrenk, W. G. (Kansas State Univ., Manhattan). Spectrochim. Acta, Part B; 30B: No. 2, 45-53 (Feb 1975).

The ARC spectrum of scandium was investigated from 2300 to 9000 Å with a 3.4 m Ebert spectrograph and more than 1500 scandium lines were measured with an accuracy of from ±3 to ±15 mÅ. The Zeeman effect was observed with a field strength of 24,025 G. From an energy-level analysis 14 previously accepted levels were shown to be false. Also, 22 new even and 2 new odd levels were added to the level system, and the number of classified lines increased from 350 to 650. For 42 of the 85

even levels and for 48 of the 58 odd levels, g-values were reported. Recently Roth (J. Res. Natl. Bur. Std.; 73A: 497 (1969)) has reported on a Slater parameter least squares calculation for the $(3d + 4s)^2$ 4p configurations. His calculation gave essential agreement with experiment but he suggested several changes in assignment. Scandium spectra were studied in this laboratory for several years. A summary of the extended analysis is presented and compared with the calculation of Roth. (auth)

15443 GROUP THEORETICAL CALCULATIONS OF HYDROGENIC TWO-BODY RADIAL INTEGRALS. Crubellier, A. (CNRS, Orsay, France). J. Phys., A (London); 8: No. 4, 473-477(Apr 1975).

A group theoretical method is described for evaluating hydrogenic two-body radial integrals such as Slater or Marvin integrals. A special coupling procedure of the two SO(2, 1) Lie algebras associated with the radial wave functions of the two particles is defined. The two-body operators of interest transform like tensor operators of the coupled algebra. The Slater or Marvin integrals can finally be written as a sum of integrals very similar to Slater or Marvin integrals of the simplest possible type, this expansion being very easy to carry out since the coefficients are mainly SO(2, 1) Clebsch-Gordan coefficients (CGC). (auth)

15444 L ABSORPTION SPECTRA OF ^{57}La TO ^{63}Eu IN THEIR OXIDES. Kushwaha, M. S.; Shrivastava, B. D.; Dubey, V. S. (Vikram Univ., Ujjain, India). J. Phys., F (London).; 5: No. 4, 597-603(Apr 1975).

The L absorption spectra of the light rare earth elements ^{57}La, ^{58}Ce, ^{59}Pr, ^{60}Nd, ^{62}Sm and ^{63}Eu in their oxides were recorded photographically using a 40-cm bent crystal x ray spectrograph kept inside a vacuum chamber. The vacuum chamber was found to be very useful for obtaining good quality spectrograms. The wavelengths and the energies of the L absorption limits were reported. The white line was found to occur just at the boundary and on the high energy side of each of the L_{III} and L_{II} absorption discontinuities. The presence of the white line at the L_{III} and L_{II} edges of Ce and Pr and at the L_{II} edge of La was reported for the first time. The values of the separation of the white line peak and the corresponding absorption limit were reported. (auth)

15445 MOLECULAR QUADRUPOLES AND ATOMIC SHIELDING FACTORS. Karl, G.; Nickel, B.; Poll, J.D.; Wolniewicz, L. (Department of Physics, University of Guelph, Guelph N1G 2W1, Canada). Phys. Rev. Lett. 34: No. 21, 1302-1305 (26 May 1975).

The electronic quadrupole moments of H_2^+ and H_2 are quadratic in the internuclear distance R at short distances and the coefficient of proportionality is the quadrupole shielding factor of the He^+ or He atom, respectively. The behavior of the quadrupole moment of H_2^+ at short and long distances can be used to approximate it at all distances. (auth)

15446 TWO-PHOTON ABSORPTION SPECTROSCOPY OF METASTABLE HYDROGEN-LIKE ATOMS. Au, C. K. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). Phys. Lett., A; 51: No. 7, 442-444(21 Apr 1975).

Recent experimental technology points to the possibility of measuring the 2S-3S transition in hydrogen-like atoms via two-photon absorption. The non-relativistic amplitude for this process is evaluated exactly and numerical values are given. (auth)

15447 OFF-DIAGONAL HYPERFINE STRUCTURE INVESTIGATIONS IN ^{45}Sc WITH THE ATOMIC BEAM MAGNETIC RESONANCE METHOD. Gebauer, H.; Aldenhoven, R.; Aydin, R. (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Phys. Lett., A; 51: No. 7, 417-418(21 Apr 1975).

The off-diagonal magnetic dipole hyperfine structure constant has been measured in the atomic ground state $3d4s^2\ ^2D_{\frac{3}{2}}$ of ^{45}Sc with the atomic beam magnetic resonance method. (auth)

15448 ON THE ANISOTROPY OF THE H_2–H POTENTIAL ENERGY SURFACE. Norbeck, J.M.; Certain, P.R.; Tang, K.T. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 63: No. 1, 590-591 (1 July 1975).

There have been numerous attempts to calculate the potential energy of the H–H_2 system. In this communication, we discuss previous estimates of the anisotropy of the surface, and present new calculated results for the leading anisotropic dependence. (auth)

15449 ADIABATIC *ab initio* POTENTIAL CURVES FOR THE $B\ ^1\Sigma^+_u$ STATE OF H_2. Ford, A.L. (Department of Physics, Texas A&M University, College Station, Texas 77843); Browne, J.C.; Shipsey, E.J.; DeVries, P. J. Chem. Phys. 63: No. 1, 362-365 (1 July 1975).

There is reported here an accurate *ab initio* calculation of the fixed nuclei potential curve for the $B\ ^1\Sigma^+_u$ state of H_2 together with approximate values of the adiabatic corrections to the potential curve for this state. The state is observed to have two minima in its potential with the very small maxima occurring at approximately, $R = 5.5a_0$. Dipole transition moments and oscillator strengths for $X\ ^1\Sigma^+_g \leftrightarrow B\ ^1\Sigma^+_u$ transitions are given for a wide range of internuclear separations. (auth)

15450 ULTRANARROW, FORBIDDEN, SINGLET–TRIPLET ANTICROSSINGS IN H_2. Miller, T.A.; Freund, R.S. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 63: No. 1, 256-263 (1 July 1975).

Forbidden singlet–triplet anticrossings have been observed between different M_N levels of the $i\ (3d)\ ^3\Pi_g$, $v=1$, $N=6$ state and the W (?) $^1\Sigma^+_g$, $v=1$, $N=4$ state of H_2. As these anticrossings are rigorously forbidden in the absence of magnetic field mixing of rotational states, their widths are quite narrow, ranging from <10 to ~ 30 G. Such narrow lines allow measurements of their center positions to approximately 3 MHz. These measurements are analyzed to yield values for the zero-field separation of the singlet and triplet levels as well as linear and quadratic Zeeman parameters. Analysis of the widths and intensities of the nine observed anticrossings yields the radiative lifetimes of the singlet and triplet states as well as the spin–orbit perturbation between them. The spin–orbit coupling between the singlet and triplet states is found to be much larger than expected from measurements of diagonal fine structure in similar triplet states. (auth)

15451 SEPARATED-OSCILLATORY-FIELDS MEASUREMENT OF THE LAMB SHIFT IN H, $n=2$. Lundeen, S.R.; Pipkin, F.M. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 22, 1368-1370 (2 June 1975).

The separated-oscillatory-field technique has been used with a fast atomic beam to measure in zero magnetic field the $2^2S_{1/2}$–$2^2P_{1/2}$ Lamb-shift interval in hydrogen. Resonance lines narrower than the natural linewidth by a factor of 3 were used to obtain $S\ (H, n=2) = 1057.893(20)$ MHz. This result has a factor of 3 increase in precision over earlier measurements. (auth)

15452 BORN AND FOUR-STATE CALCULATIONS FOR THE EXCITATION OF THE $(2p)^5 3s$ AND $(2p)^5 3p$ LEVELS OF NEON BY PROTON IMPACT. Albat, R.; Gruen, N. (Univ., Giessen, Ger.). J. Phys., B (London); 8: No. 6, 959-964(21 Apr 1975).

For the singlet levels of $(2p)^5 3s$ and $(2p)^5 3p$ of the Ne atom wavefunctions of Hartree-Fock type are constructed. The Born calculations yield the new Bethe parameter $b_n = 0.050$ for the $(2p)^5 3p$ states. A four-state impact parameter calculation is carried out including the states $^1S\ (2p)^6$, $^1S\ (2p)^5 3p$ and $^1P\ (2p)^5 3s$ ($M = 0, 1$). With this relatively simple model all known experimental data for the excitation of $(2p)^5 3s$ and $(2p)^5 3p$ by proton impact can be explained satisfactorily. (auth)

15453 CONFIGURATION INTERACTION STUDIES OF BOUND, LOW LYING STATES OF N_2^-, N_2, N_2^+ AND N_2^{2+}. Thulstrup, E. W.; Andersen, A. (Aarhus Univ., Denmark). J. Phys., B (London); 8: No. 6, 965-976(21 Apr 1975).

Complete valence shell CI calculations have been carried out for a large number of non-Rydberg states of the N_2 molecule and related ions. Full potential curves are presented for these states, and are used for a calculation of spectroscopic properties. Comparison is made with experimental data where such are available, and several new states and their properties are predicted. Some of these are of great interest in connection with the observation of unidentified states in recent experiments. (auth)

15454 CALCULATED BORN AND FOUR-STATE CROSS SECTIONS OF LOW LYING AR LEVELS EXCITED BY PROTON AND ELECTRON IMPACT. Albat, R.; Gruen, N.; Wiram, B. (Univ., Giessen, Ger.). J. Phys., B (London); 8: No. 6, L82-L85 (21 Apr 1975).

The excitation of $(3p)^5 4s$ and $(3p)^5 4p$ levels of Ar is investigated by use of the Born approximation and a four-state calculation including $^1S_0(3p)^6$, $^1S_0(3p)^5 4p$ and $^1P_1(3p)^5 4s$ ($M = 0,1$). HF-type wavefunctions are used. The spin-orbit coupling is treated in a rather semiempirical way. (auth)

15455 INADEQUACY OF THE MOMENTUM-TRANSLATION APPROXIMATION: MULTIPHOTON IONIZATION OF ATOMIC HYDROGEN. Rachman, A.; Laplanche, G. (Univ., Poitiers, France). J. Phys., B (London); 8: No. 6, 826-841(21 Apr 1975).

The cross section for multiphoton ionization of hydrogen is computed using the momentum translation method (MTA) in the cases of linearly and circularly polarized light, alternatively. Extended numerical comparison is made with well-established results obtained from the Nth-order time-dependent perturbation theory in the weak intensity limit. The MTA does not reproduce the values given by perturbation theory and considerable differences are observed. Higher order iterations than the lower one are introduced and an analysis of the leading terms of the development is made: at weak intensities the zeroth-order term that defines the MTA cancels with higher order terms and the final result obtained after making (N−1) iterations is none other than the well-known transition amplitude deduced from standard

perturbation theory, defined by the remaining terms of the last iteration after mutual cancellation with lower-order ones. According to the results obtained in this work, it is not possible to affirm that the MTA is adequate to calculate atomic multiphoton ionization cross sections. (auth)

15456 ATOMIC FORM FACTOR AND INCOHERENT SCATTERING FUNCTION OF Ar. Naon, M. (Centre de Mecanique Ondulatoire Appliquee, Paris); Cornille, M.; Kim, Y. K. J. Phys., B (London); 8: No. 6, 864-868(21 Apr 1975).

The atomic form factor and the incoherent scattering function of Ar calculated from the Bethe-Goldstone method are presented. The results include electron correlation effects in the M shell as well as those between the L and M shells. The form factor calculated from the Hartree-Fock wave-function agree within 2% with the result from the Bethe-Goldstone method for a wide range of momentum transfer. However, the correlation effects reduce the incoherent scattering function for small momentum transfers ($\lesssim 1$ au) by about 20% from the Hartree-Fock values. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

15457 (LA-tr-75-1) INVESTIGATION OF PROPERTIES OF A SUBSTANCE BY POLARIZED MUONS. Gurevich, I. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Jan 1975. Translation by Helen J. Dahlby of JINR-D1-6349. (CONF-710911-16). 25p. Dep. NTIS $4.25.

It is considered that by measuring the polarization of the muons in different magnetic fields as a function of time, it is possible to study diverse physico-chemical properties of the substance and the behavior of the muons. The examples pointed out are the kinetics of the rapid chemical reactions of the hydrogen-like atom μ^+e^- (muonium) and the mesoatoms μ^-Z formed in the medium, the size of the muonium atom in different substances, and the dipole interactions of muons with the magnetic moments of nuclei and electrons, and the position of the muon in the crystal lattice and its diffusion. (JFP)

15458 MUONIC X RAYS IN LEAD ISOTOPES. Kessler, D.; Mes, H.; Thompson, A.C. (Carleton University, Ottawa, Canada K1S 5B6); Anderson, H.L.; Dixit, M.S.; Hargrove, C.K.; McKee, R.J. Phys. Rev. C 11: No. 5, 1719-1734 (May 1975).

Results of an experiment to measure muonic transition energies in separated lead isotopes are presented. The main results are as follows: 1. Muonic spectra of the four lead isotopes ^{204}Pb, ^{206}Pb, ^{207}Pb, and ^{208}Pb were studied with high resolution. No anomalous splitting or broadening of the lines was detected. The effect of the natural linewidth could, however, be observed. 2. An anomaly was found in the 3*d* fine structure splitting whose measured value turned out to be larger than the calculated value by nearly 300 eV (or 10 standard deviations) in all four isotopes. 3. Except for this anomaly, the lower levels of muonic lead can be described adequately with the help of a two-parameter Fermi distribution of the nuclear charge. There is no evidence in the x-ray data for a central depression in the nuclear density. 4. We determine the nuclear polarization in the ground state of all four isotopes of lead and find values ranging from -7.3 ± 2.2 to -10.1 ± 1.1 keV, which are somewhat higher than, but not inconsistent with, the best theoretical predictions of -6.8 ± 2.0 keV. This analysis is made possible by our ability to measure the weak transitions involving the 2*s* level. 5. We find a slight and regular increase in nuclear density, going from ^{204}Pb to ^{208}Pb. The skin-thickness parameter *t* appears, however, to be practically the same in all four isotopes measured. (auth)

15459 LIFETIME SPECTRA OF POSITRONS IN IONIC COMPOUNDS. Noguchi, M. (Japan Atomic Energy Research Inst., Tokyo); Chiba, T.; Kishimoto, Y.; Tsuda, N. (National Inst. for Researches in Inorganic Materials, Sakura, Ibaraki (Japan)). Appl. Phys.; 3: No. 5, 383-385(May 1974).

From international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973). 1 fig.; 2 tabs.; 6 refs. Also published as AED-Conf-73-328-015.

Lifetime spectra of some sulphides, AlN, and SiC consist of two components. Temperature dependences of the spectra of Sb_2S_3 were investigated from 298 to 723 K and analyzed with a nontrapping model. It was estimated that cation vacancies due to nonstoichiometry were responsible for the τ_2 component. (auth)

15460 MOTION OF POSITRONS IN METALS. Bergersen, B. (British Columbia Univ., Vancouver (Canada). Dept. of Physics); Pajanne, E. (Ahlstroem (A.) Oy, Karhula (Finland). Karhulan Tehtaat). Appl. Phys.; 4: No. 1, 25-35(Jun 1975).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973). 2 figs.; 2 tabs.; 88 refs.

In this review the different aspects of positron annihilation in metals that involve the dynamics of positron motion before annihilation are discussed. The emphasis is on the theory, but also some experimental evidence is quoted. The topics covered are: Slowing down and thermalization, effective mass, temperature dependence of positron vacancy trapping, positron channeling, and escape of low energy positrons from metal surfaces. (auth)

15461 POSITRON ANNIHILATION IN IONIC CRYSTALS. Balogh, A. (Magyar Tudomanyos Akademia, Budapest. Research Group for Crystal Physics); Dezsi, I.; Horvath, D.; Kajcsos, Z. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Appl. Phys.; 6: No. 1, 21-23(Jan 1975).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973). 4 figs.; 6 refs.

Positron lifetime measurements were made on Ca^{2+} doped NaCl, Ba^{2+} doped NaCl and x-ray- and additively-colored KCl crystals. In the NaCl(Ca) system a correlation which would be approximated by a power equation was found between the dopant concentration and the positron annihilation parameters. In the NaCl(Ba) system the decay parameters do not change significantly as expected and no significant difference in the decay parameters of the colored and uncolored crystals could be found. (auth)

15462 FORMATION OF THE MUONIC HELIUM ATOM, $\alpha\mu^-e^-$, AND OBSERVATION OF ITS LARMOR PRECESSION. Souder, P.A.; Casperson, D.E.; Crane, T.W.; Hughes, V.W.; Lu, D.C.; Orth, H.; Reist, H.W.; Yam, M.H. (Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520); zu Putlitz, G. Phys. Rev. Lett. 34: No. 23, 1417-1420 (9 June 1975).

The muonic helium atom, $\alpha\mu^-e^-$, has been formed by stopping polarized negative muons in He gas at 14 atm with a Xe admixture of 2%, and observed through its characteristic Larmor precession frequency of 1.4 MHz/G. In addition, a nonzero residual polarization of $P=0.06\pm0.01$ for μ^- stopped in pure He gas has been measured for the first time, which corresponds to a depolarization factor of 18 ± 3. (auth)

15463 ISOBARIC MODEL FOR THE P-WAVE PION-NUCLEON SCATTERING VOLUMES IN PIONIC ATOMS. Ohta, K. (Tokyo Univ. (Japan). Dept. of Physics). Phys. Lett., B; 56: No. 4, 339-342(12 May 1975).

The effective Lagrangian model is studied for construction of the P-wave interaction volumes in free space and in nuclear media. The mass shift of the N* isobar arising from the Pauli correction and the local field correction is calculated allowing the π and ρ exchange to be responsible for the $NN^* \rightarrow N^*N$ transition potential. (auth)

15464 POSITRON ANNIHILATION IN SOME TRANSITION METAL OXIDES. Cizek, A.; Sob, M. (Ceskoslovenska Akademie Ved, Brno. Ustav Fyzikalni Metalurgie). (Phys. Lett., A; 53: No. 1, 65-66(19 May 1975).

The constant value of the total half-width of the angular correlation spectrum and the momentum corresponding to the absolute maximum of the annihilation photon distribution was found for TiO_2, VO_2, NbO_2, MoO_2 and Al_2O_3 in agreement with the "optical" model. Its value follows also from the Gaussian curve fitting experimental results. (auth)

Collision Phenomena

Refer also to abstracts 14416, 15085, 15439, 15440, 15452, 15454, 15456, and 15735.

15465 (CEA-R-4660) CALCULATION OF EXCITATION COEFFICIENT BY ELECTRON IMPACT. Kato, T. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette(France). Service d'Electronique Physique). Apr 1975. 10p. (In French). INIS.

The method to calculate the collision excitation coefficient proposed by Mewe is discussed. The calculated values of oscillator strength Ω_M by the method of Mewe (1972a) are compared with theoretical and experimental values Ω which are more precise than the values of Mewe. Mewe's method is valid within factor of four, and the mean value of Ω_M/Ω is 1.9. Mewe's value Ω_M are compared with the values $\Omega_{T\text{-}K}$ calculated by Tucker and Koren (1971). (auth)

15466 (ORO-3027-30) EXCITATION AND IONIZATION OF IONS BY ELECTRON IMPACT. Technical Progress Report, September 1, 1974–May 31, 1975. Feeney, R. K.; Divine, T. F.; Kovac, R. M.; McPherson, D.; Sayle, W. E. (Georgia Inst. of Tech., Atlanta (USA). School of Electrical Engineering). 31 May 1975. Contract AT(40-1)-3027. 37p. Dep. NTIS $5.00.

This effort is devoted to experimental measurements of electron impact excitation and ionization cross sections of ions. The cross

sections of interest are those of importance in the diagnostics of CTR plasmas. Current tasks include: the completion of absolute measurements of the electron impact cross sections for Rb^+, Cs^+, and Tl^+ ions; and determination of the absolute electron impact excitation cross sections for selected transitions in Li^+ and other He-, Li-, and Be-like ions. (JFP)

15467 (SUNI-37, pp 28-29) ABSOLUTE CROSS SECTION MEASUREMENT FOR K_α X-RAY PRODUCTION EXCITED BY Ar–Ar COLLISIONS. Lutz, H. O.; McMurray, W. R.; Pretorius, R.; van Heerden, I. J.; van Reenen, R. 1974.
In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15468 (SUNI-37, pp 29-30) THRESHOLD BEHAVIOR OF MOLECULAR-ORBITAL X-RAY EMISSION DURING Xe–Au COLLISIONS. Lutz, H. O.; McMurray, W. R.; Pretorius, R.; van Heerden, I. J.; van Reenen, R. 1974.
In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15469 (SUNI-37, pp 30-31) RADIATIVE-ELECTRON-CAPTURE DURING PROTON IRRADIATION OF HYDROGEN. Lutz, H. O.; McMurray, W. R.; Pretorius, R.; van Heerden, I. J.; van Reenen, R. 1974.
In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15470 ONE METHOD OF DETERMINING ABSOLUTE VALUES OF THE EFFECTIVE CROSS-SECTIONS FOR SECOND-ORDER COLLISIONS OF Hg (6^3P) AND Hg (6^3P_2) ATOMS WITH SLOW ELECTRONS. Korotov, A. I. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 42-45(1975). (In Russian).
A formula is obtained for determining absolute values of effective cross sections $q_{21}(u)$ for second-order collisions of excited atoms with slow electrons. In order to determine $q_{21}(u)$ it is necessary to measure the current to a collector, caused by the second-order collisions, and the effective lifetime of the level under study. Calculation of $q_{21}(u)$ is carried out for Hg (6^3P_0) and for Hg (6^3P_2). The value of $q_{21}(u)$ is determined for slow electron energies (u) of 0.13 and 0.3 eV respectively. In the case of Hg (6^3P_0) the value of $q_{21}(u)$ is 2.6×10^{-15} cm^2 at u = 0.13 eV, and for Hg (6^3P_2) it is 1.1×10^{-15} cm^2 at u = 0.3 eV. A comparison and discussion of the results is carried out with other experimental and theoretical data. (SJR)

15471 SCATTERING OF POSITRONS BY HELIUM: TOTAL CROSS SECTIONS UP TO 270 eV. Jaduszliwer, B.; Nakashima, A.; Paul, D. A. L. (Univ. of Toronto). Can. J. Phys.; 53: No. 10, 962-967(15 May 1975).
The total cross sections for the scattering of positrons by helium were measured by the method of transmission in the 16 to 270 eV energy range. The experimental results are higher than those of Canter et al. but are in reasonable agreement with recent results of Griffith et al., and at high energies tend towards Born approximation calculations. The integral of the cross section over the positron momentum is smaller than the sum rule estimate made by Bransden et al. A tentative value of $(0.034 \pm 0.017)\ \pi a_0^2$ is assigned to the positronium formation cross section at threshold. (auth)

15472 INTERACTION OF ELECTRON AND ION BEAMS OF FINITE CROSS SECTION. Tseytlin, M. B.; Tolmachev, M. M. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 5, 92-95(May 1974).
Translated from Radiotekh. Elektron.; 19: No. 5, 1041-1045 (May 1974).
The results of a theoretical study of wave propagation in electron and ion beams of finite cross section are presented. It is shown that in the amplification mode of operation in such a system the condition $\omega_{pe}/\omega \ll 1$, usually used for calculations, cannot be satisfied. The dependence of the plasma frequency reduction factor on the dimensionless beam radius for large values of the parameter ω_{pe}/ω is given. It is shown that in this case simplification of the theory leads to considerably reduced values of the plasma frequency reduction factors. (auth)

15473 MEASUREMENT OF ELECTRON AFFINITIES OF O_3, SO_2, AND SO_3 BY COLLISIONAL IONIZATION. Rothe, E. W.; Tang, S. Y.; Reck, G. P. (Wayne State Univ., Detroit). J. Chem. Phys.; 62: No. 9, 3829-3831(1 May 1975).
Relative cross sections were measured for the formation of parent anions of NO_3, O_2, SO_2, O_3, and SO_3 as a result of collisions with energetic cesium atoms. The data presented were obtained at energies near threshold and electron affinities were deduced for the latter three molecules. The best values for the electron affinities are for SO_2, 1.14 ± 0.15 eV; for O_3, 2.14 ± 0.15 eV; and for SO_3, 1.70 ± 0.15 eV. (JFP)

15474 CONVERGENCE OF THE ELASTIC AND THE INELASTIC COLLISION CROSS SECTIONS IN THE COUPLED-STATES AND THE CLOSE-COUPLING METHODS. McGuire, P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). Chem. Phys.; 8: No. 1, 231-238(Apr 1975).
The study of atom-diatom elastic and rotationally and vibrationally inelastic collisions is considered in the recently developed coupled-states approach in which the body-fixed coupled equations are approximated by the neglect of inter-multiplet coupling and the eigenvalue of the orbital angular momentum operator $\hat{l}^2$ is approximated by $\hbar l(l+1)$. The rate of convergence with respect to molecular basis expansion for the coupled-states cross sections is presented for He-H_2 collisions at 0.65 eV along with a comparison to the corresponding close-coupling cross sections computed in the standard fixed-space coordinate system. For elastic and rotationally inelastic scattering, the coupled-states and close-coupling convergence properties are similar while for vibrational transition cross sections, the convergence is irregular. It is found in general that the coupled-states method is a more reliable approximation when fully converged cross sections are computed. (auth)

15475 INVESTIGATION OF THE CHEMICAL REACTIONS H + H_2 AND H + D_2 BY A HYDROGEN MASER. Gordon, E. B.; Ivanov, B. I.; Perminov, A. P.; Medvedev, E. S.; Ponomarev, A. N.; Tal'roze, V. L. (AN SSSR: Moscow. Inst. Khimicheskoj Fiziki). Chem. Phys.; 8: No. 1, 147-157(Apr 1975).
The rate constants of the gaseous chemical reactions H + H_2 → H_2 + H(I) (k = $4.4 \pm 0.5 \times 10^{-14}$cm^3/molec.s at T = 440K and $8.2 \pm 0.8 \times 10^{-14}$cm^3/molec.s at T = 470K) and H + D_2 → HD + D(II) (k = $2.35 \pm 0.3 \times 10^{-14}$cm^3/molec.s at T + 470K) were measured by a method using an H-maser as a highly sensitive relaxometer for hyperfine levels of hydrogen atoms. From the ratio between the reaction rate constant and the rate constant for the coherence change induced by collision of the partners - which appeared to be 4/3 for reaction (I) and 1.0 for reaction (II) - the conclusion was made that the change in nuclear magnetic states of the partners [ortho-para conversion for reaction (I)] occurs by transition of the heavy particle only, i.e., as a result of the chemical reaction. Theoretical analysis of the changes in population of the H-atom hyperfine levels and the H_2-molecule nuclear sublevels as a result of reaction (I) was carried out under the assumption of a small perturbation of the magnetic momenta. For the linear and triangular H_3 complexes it was found that the rate constant of reaction (I) is related to that of the complex formation as $k_H = \frac{1}{2}k_c^L$ and $k_H = \frac{2}{3}k_c^T$, respectively. (auth)

15476 PROTON TRANSFER REACTIONS FROM H_3^+ IONS TO N_2,O_2 AND CO MOLECULES. Kim, J. K.; Theard, L. P.; Huntress, W. T. Jr. (Jet Propulsion Lab., Pasadena, Calif. (USA)). Chem. Phys. Lett.; 32: No. 3, 610-614(1 May 1975).
The rate constants for proton transfer from H_3^+ ions to N_2,O_2, and CO were measured as function of hydrogen buffer gas partial pressure. The rate constant for proton transfer from H_3^+ to N_2 shows a very large pressure dependence, increasing from 1.0×10^{-9} cm^3/s at low H_2 partial pressures to 1.7×10^{-9} cm^3/s at high H_2 partial pressures. The rate constants for proton transfer from H_3^+ to O_2 and CO are constant with partial pressure of H_2; giving values of 6.4×10^{-10} cm^3/s and 1.7×10^{-9} cm^3/s, respectively. The roles of excess vibrational energy in H_3^+ ions and of equilibrium between forward and backward reaction are discussed. The backward reaction is observed only for the reaction of H_3^+ ions with O_2, and an equilibrium constant of K = 2.0 ± 0.4 at 298 K was determined. From these data the proton affinity of O_2 is deduced to be 0.47 ± 0.11 kcal/mole higher than that of H_2. (auth)

15477 ON THE REACTION OF KR^+ WITH HYDROGEN. Smith, R. D.; Smith, D. L.; Futrell, J. H. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). Chem. Phys. Lett.; 32: No. 3, 513-516(1 May 1975).
The reaction of $Kr^+(^2P_{\frac{1}{2}})$ and $Kr^+(^2P_{\frac{3}{2}})$ with H_2 are examined using a conventional ICR and a tandem Dempster-ICR instrument. The accidentally near-resonant charge-transfer reaction CO^+ with Kr was used to prepare a nearly pure $^2P_{\frac{1}{2}}$ state Kr^+ beam to evaluate rates of reaction of the $^2P_{\frac{1}{2}}$ and $^2P_{\frac{3}{2}}$ state with H_2. It was found that the $Kr^+(^2P_{\frac{1}{2}})$ reacts faster than the $Kr(^2P_{\frac{3}{2}})$ and a negligible activation energy exists for both reactions. (auth)

15478 THE EFFECT OF NEUTRAL MOLECULE VIBRATIONAL ENERGY CONTENT IN MOLECULAR H_2^+-H_2 CHARGE-TRANSFER REACTIONS. Flannery, M. R.; Hornstein, J. V.; Moran, T. F. (Georgia Inst. of Tech., Atlanta (USA)). Chem. Phys. Lett.; 32: No. 3, 455-457(1 May 1975).
The cross sections for H_2^+–H_2 charge-transfer reactions of vibrationally excited neutral target molecules were computed

as a function of kinetic energy using a multistate impact parameter treatment. The cross sections involving vibrationally excited neutrals are significantly larger than those involving ground state reactants. (auth)

15479 ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOM IN A LASER FIELD. Choudhury, B. J.; Bhakar, B. S. (Manitoba Univ., Winnipeg (Canada). Dept. of Physics). Phys. Lett., A; 51: No. 8, 479-480(5 May 1975).

The cross sections for the elastic scattering of electrons by hydrogen atoms in the presence of a laser field were calculated in the Glauber and the Born approximations. The Born approximation was found to underestimate the cross sections and the increase of the intensity of the electromagnetic field is found to lower the cross sections. (auth)

15480 BROADENING OF LEVEL-CROSSING SIGNALS IN $5^2P_{\frac{1}{2}}$ STATE OF ^{87}Rb AND ^{85}Rb BY COLLISIONS WITH NOBLE-GAS ATOMS. Lukaszewski, M. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej)). Phys. Lett., A; 51: No. 8, 481-482(5 May 1975).

Depolarization of resonance $5^2P_{\frac{1}{2}}$ state of rubidium in collisions with nobel-gas atoms was studied experimentally by the level-crossing technique. Systematical disagreement between the experimental results and theoretical predictions suggests a need of further improvements in the theory. (auth)

15481 TRANSFER OF EXCITATION FROM THE $4D_{\frac{5}{2}}$ LEVEL TO THE $4D_{\frac{3}{2}}$ LEVEL OF SODIUM INDUCED IN COLLISION WITH NEON ATOMS. Biraben, Francois; Cagnac, Bernard; Grynberg, Gilbert (Ecole Normale Superieure, 75 - Paris (France). Lab. de Spectroscopie Hertzienne). Compt. Rend., Ser. A, B; 280: No. 8, 235-238(24 Feb 1975). (In French).

Two-photon spectroscopy without Doppler broadening was used to measure the transfer of excitation from the $4D_{\frac{5}{2}}$ level to the $4D_{\frac{3}{2}}$ level of sodium induced in collision with neon atoms. (auth)

15482 ALGEBRAIC VARIATIONAL METHOD: A QUANTITATIVE ASSESSMENT IN e^+-H SCATTERING. Register, D.; Poe, R. T. (California Univ., Riverside (USA). Dept. of Physics). Phys. Lett., A; 51: No. 7, 431-433(21 Apr 1975).

A quantitative assessment is made of the Harris-Nesbet algebraic variational method. Calculations on e^+-H scattering with a Hylleraas basis provide extremely accurate resonant and non-resonant results. In particular, definitive D wave phase shifts are obtained. (auth)

15483 DOUBLE ELECTRON CAPTURE BY PROTONS FROM HELIUM. Roy, K.; Mukherjee, S. C.; Sural, D. P. (Indian Association for Cultivation of Science, Calcutta). Phys. Lett., A; 51: No. 7, 439-441(21 Apr 1975).

The double electron capture process for protons passing through helium is studied using the impact parameter method in the atomic state expansion. The effects of the translatory motion of the electrons and the Pauli principle have been incorporated. (auth)

15484 STUDIES BY THE ELECTRON CYCLOTRON RESONANCE (ECR) TECHNIQUE. VIII. Interactions of Low Energy Electrons with the Chlorine-Containing Molecules CCl_4, $CHCl_3$, CH_2Cl_2, $C_nH_{2n+1}Cl$ (n = 1 to 4), C_2H_3Cl, $COCl_2$, NOCl, CNCl and Cl_2. Schultes, E.; Christodoulides, A. A.; Schindler, R. N. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. Fuer Physikalische Chemie). Chem. Phys.; 8: No. 3, 354-365 (May 1975).

Rate constants, in some cases also activation energies and energy dependences, were measured for the capture of low energy electrons by the molecules CCl_4, $CHCl_3$, CH_2Cl_2, $C_nH_{2n+1}Cl$ (n = 1 to 4), C_2H_3Cl, $COCl_2$, NOCl, CNCl and Cl_2. Potential energy curves were calculated for a number of negative ions. For ineffective scavengers the possibility of contributing scattering effects on the observed changes in signal intensity upon electron energy variation is indicated. In CCl_4 the observed energy dependence suggests the existence of intermediate negative ions. For Cl_2 good agreement was obtained between the calculated curves based on experimental data for electron capture and a recent self-consistent field analysis. (auth)

15485 ELECTRIC QUADRUPOLE STATE SELECTORS FOR MEASUREMENTS OF ROTATIONAL STATE DISTRIBUTIONS OF REACTIVELY SCATTERED MOLECULES. Mosch, J. E.; Safron, S. A.; Toennies, J. P. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Chem. Phys.; 8: No. 3, 304-323(May 1975).

The analysis of internal quantum state distributions of product molecules formed in molecular beam scattering studies of chemical reactions provides a sensitive test of reaction theories. The electrostatic quadrupole state selector can be used to measure directly the rotational state distribution of polar molecules. The method has the advantage over all others in that the rotational state distribution can be measured at a given arbitrary scattering angle and final velocity. The method has already been used to study the reaction Rb + Br_2 → RbBr + Br and Rb + HBr → RbBr + H. It has also been used to characterize a Xe seeded CsF nozzle beam. The apparatus used, its theory of operation, the methods for evaluating the experimental data, and some results from the above mentioned experiments are described in detail. (auth)

15486 SHORT-RANGE He–Xe INTERACTION FROM MOLECULAR-BEAM SCATTERING. Amdur, I.; Engler, M.J.; Jordan, J.E. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Mason, E.A. J. Chem. Phys. 63: No. 1, 597-597 (1 July 1975).

The short-range interaction potential between He and Xe has been determined from elastic scattering of beams of fast He atoms with room temperature Xe. The results are compared with previous experimental and theoretical results. (AIP)

15487 QUANTUM MECHANICAL STUDIES OF COLLISION INDUCED DISSOCIATION: DISCRETIZATION THEORY. Wolken, G. Jr. (Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio 43201). J. Chem. Phys. 63: No. 1, 528-533 (1 July 1975).

The collinear collision of an atom with a diatomic molecule A + (B,C) is formulated quantum mechanically using the close coupling approach. Neglecting rearrangement collisions but including electronically adiabatic inelastic and dissociative processes, it is shown that the resulting continuously infinite set of coupled differential equations can be reformulated as a discrete set of coupled differential equations. The technique is analogous to a procedure developed to treat gas–solid energy transfer. However, the boundary conditions involving three free particles in the final state has no analog in the gas–solid formulation of the problem. These are formulated also in terms of the discretized equations, and various simplifications and symmetries of the equations are discussed. (auth)

15488 FESHBACH RESONANCES ASSOCIATED WITH RYDBERG STATES OF THE HYDROGEN HALIDES. Spence, D.; Noguchi, T. (Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 63: No. 1, 505-514 (1 July 1975).

Using an electron transmission spectrometer we locate Feshbach resonances in the hydrogen halides HF, HCl, HBr, and HI. These resonances consist of two Rydberg electrons bound to a positive ion core grandparent state. By analysis of previously published data, we determine the electron configurations of resonances observed in the isoelectronic rare gases and hence deduce the electron configurations of the resonances observed in HCl, HBr, and HI. We find that most of the observed resonances whose grandparent positive ion states have term value $X\,^2\Pi$ are associated with Rydberg parent states of symmetry $[X\,^2\Pi]ns\sigma$, $[X\,^2\Pi]np\sigma$, and $[X\,^2\Pi]nd\Delta$. In HF, only one resonance series, associated with the $[X\,^2\Pi]3s\sigma\,^{1,3}\Pi$ Rydberg state is observed. (auth)

15489 QUASICLASSICAL TRAJECTORY STUDIES USING 3D SPLINE INTERPOLATION OF *ab initio* SURFACES. Sathyamurthy, N.; Raff, L.M. (Department of Chemistry, Oklahoma State University, Stillwater, Oklahoma 74074). J. Chem. Phys. 63: No. 1, 464-473 (1 July 1975).

The accuracy of spline fitting procedures has been investigated for Morse potentials, Lennard-Jones potentials, a collinear D–Cl–H potential surface, and for three dimensional DIM ($He–H^+_2$) and a valence-bond D–Cl–H surface. The adequacy of 3D spline surfaces in quasiclassical trajectory studies has been examined for both the $He–H^+_2$ and D+HCl systems. It is found that while one dimensional spline fits are very accurate, this accuracy decreases substantially for a two-dimensional spline fit. There is an additional, but smaller, decrease in accuracy for three-dimensional splines. The surface gradients are found to be less accurately fitted than the corresponding function values. In general, (15×15×15) cubic spline fits are found to lack the necessary accuracy to produce a point-by-point match of a quasiclassical trajectory to that obtained on the original analytic surface. However, total reaction cross sections, energy partitioning distributions, and spatial scattering distributions computed on spline surfaces are found to be in good accord with those obtained from the full analytic surface. This suggests that in spite of their limited accuracy, spline fits may provide a very useful tool for interpolation of *ab initio* surfaces. The computer time requirements for use of 3D cubic splines in quasiclassical trajectory calculations are found to be within range of present computational facilities. (auth)

15490 MULTIPLE SCATTERING THEORY. I. OFF-SHELL *t* MATRIX ELEMENTS AND MOMENTUM SPACE WAVEFUNCTIONS FOR LOCAL TWO BODY POTENTIALS. Brumer, P. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138); Shapiro, M. J. Chem. Phys. 63: No. 1, 427-437 (1 July 1975).

An efficient method for computing off-shell *t* matrix elements and bound state momentum space wavefunctions for *any* local two body

potential is presented. Applications are made to several sample atom–atom interactions. (auth)

15491 THE COMPTON PROFILE OF WATER: COMPUTED FROM AN SCF-MO WAVEFUNCTION IN A DOUBLE-ZETA GAUSSIAN BASIS SET. Snyder, L.C.; Weber, T.A. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 63: No. 1, 113-114 (1 July 1975).

The Compton profile of water has been computed by the Dirac transformation of an SCF-MO position-space wavefunction in a double-zeta quality Gaussian basis set. This theoretical Compton profile agrees with the experimental one of Reed and Eisenberger within their estimated experimental error. (auth)

15492 APPARENT OSCILLATOR STRENGTHS FOR MOLECULAR OXYGEN DERIVED FROM ELECTRON ENERGY-LOSS MEASUREMENTS. Huebner, R.H. (Argonne National Laboratory, Argonne, Illinois 60439); Celotta, R.J.; Mielczarek, S.R.; Kuyatt, C.E. J. Chem. Phys. 63: No. 1, 241-248 (1 July 1975).

Oscillator strengths for O_2 from 6 to 14 eV are derived from the energy-loss spectrum of 100 eV incident electrons. Integrated f values for the Schumann–Runge bands and continuum, which span four orders of magnitude in intensity, agree well with high-resolution photoabsorption measurements. Vibrational structure superimposed on the Schumann–Runge continuum, previously assigned to the $(3s\sigma_g)$ $^3\Pi_g$ Rydberg state, contributes less than 0.5% to the total oscillator strength determined for that region. These data also yield f values for discrete bands in the region between 9.5 and 14.0 eV, where line saturation problems complicate oscillator strength analysis of the optical data. An oscillator strength sum of 0.198 is obtained for all transitions below the ionization potential at 12.07 eV. (auth)

15493 RELATIVE CROSS SECTIONS IN ELECTROIONIZATION. Marmet, P. (Département de Physique, Université Laval, Québec 10, Canada). J. Chem. Phys. 63: No. 1, 249-255 (1 July 1975).

Electron impact ionization efficiency curves showing vibrational states of NO^+ and O^+_2 are presented just above their ionization threshold. These results and other recent ones prove that the competition between different cross sections must be taken into account in order to explain a good many electron impact data. (auth)

15494 IONIZATION AND ELECTRON CAPTURE IN NEON K VACANCY PRODUCTION FROM N-Ne COLLISIONS. Hopkins, F.; Brenn, R.; Whittemore, A. R. (State Univ. of New York, Stony Brook (USA). Dept. of Physics); Cue, N. (State Univ. of New York, Albany (USA). Dept. of Physics); Chaturvedi, R. P. (Department of Physics, State University of New York, Cortland, New York 13045, USA). Phys. Lett., A; 53: No. 1, 79-81(19 May 1975).

The measurements of Ne K and N K X-ray cross sections for $N^{3+,4+,5+,6+,7+}$ ions incident on a thin Ne target at energies from 9 to 54 MeV indicate that charge exchange plays a minor role compared to ionization in producing Ne K vacancies over that energy range. (auth)

15495 PHOTODETACHMENT MEASUREMENTS OF H^- NEAR THRESHOLD. Feldmann, D. (Hamburg Univ. (F. R. Germany). 1. Inst. fuer Experimental physik). Phys. Lett., A; 53: No. 1, 82(19 May 1975).

From the measured threshold dependence of the cross section the electron affinity of H is found to be 0.7539 eV ± 0.002 eV. (auth)

15496 EFFECT OF INTENSITY ON ANGULAR DISTRIBUTION OF PHOTOELECTRONS IN MULTIPHOTON IONIZATION. Gontier, Y.; Rahman, N. K.; Trahin, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service de Physique Atomique). Phys. Lett., A; 53: No. 1, 83-84(19 May 1975).

It is shown that at large external electromagnetic field, the usual angular distribution of the photoelectrons in multiphoton ionization is modified. New experiments are suggested to detect such effects. (auth)

15497 EXCITATION OF NEON AND HELIUM LINES IN COLLISION BETWEEN ELECTRONS AND METASTABLE ATOMS. Mityureva, A.A.; Penkin, N.P. Opt. Spectrosc. (USSR) 38: No. 2, 229-230 (Feb 1975).

The excitation of atoms from excited states by electron collision (stepwise excitation) is often of primary importance among other excitation processes. Thus information on the dependence of the effective cross sections of these processes on the energy of the colliding particles, that is, the excitation functions, is of considerable interest. (auth)

15498 EXCITATION OF ALKALINE-EARTH ATOMS BY ELECTRON IMPACT. 5: BARIUM. Aleksakhin, I.S.; Zapesochnii, I.P.; Garga, I.I.; Starodub, V.P. Opt. Spectrosc. (USSR) 38: No. 2, 126-129 (Feb 1975).

Experimental results for the excitation of barium atoms by electron impact are presented. The barium atoms were excited by the crossed beam method. (auth)

15499 CHARGE TRANSFER CROSS SECTION. Msezane, A. (Georgia State Univ., Atlanta); Gallaher, D. F. J. Phys., B (London); 23: No. 4, L70-L72(1 Apr 1975).

A proof that the charge transfer cross section is independent of the ratio of the colliding masses is presented. It is further shown that this independence is implied in the formulation by Msezane and Gallaher. (auth)

15500 VARIATIONAL DETERMINATION OF PHASE SHIFTS FOR e–H ELASTIC SCATTERING. Rudge, M. R. H. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 6, 940-946(21 Apr 1975).

A consistent and efficient variational procedure is described and applied to the calculation of s-wave, e^--H elastic scattering phase shifts. (auth)

15501 K-SHELL IONIZATION OF ATOMS BY RELATIVISTIC ELECTRONS. Davidovic, D. M.; Moiseiwitsch, B. L. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 6, 947-958(21 Apr 1975).

The theoretical investigation carried out by Arthurs and Moiseiwitsch on the K-shell ionization of atoms by fast electrons, based on Moelier's relativistic modification of the Born approximation, has been extended to higher energies and to atoms with greater nuclear charge Z. Allowance for the difference between the theoretical and experimental ionization energies arising from the potential field of the electrons in the outer shells is made using a similar procedure to that due to Perlman. The K-shell ionization cross sections are calculated as functions of the electron impact energy for C, Al, Ni, Cu, Ag, Sn, Au and the theoretical curves obtained are compared with the available experimental data, the accordance being somewhat variable. The calculated cross sections for Ag and Sn are found to possess minima in satisfactory accordance with the data of Rester and Dance and the calculations of Kolbenstvedt. A K-shell ionization cross section curve has also been calculated for 2-MeV electrons as a function of Z and better accordance was found with the experimental data obtained by Li-Scholz et al. than the calculations of Kolbenstvedt. In addition, calculations have been carried out at electron impact energies ranging from 150- to 900-MeV for Cu, Sr, Mo, In, Tm, Ta, Au and good agreement has been obtained with the experimental data of Middleman et al. except for Cu. (auth)

15502 LOCAL OPTICAL POTENTIAL STUDY OF ELASTIC ELECTRON-ATOM SCATTERING. Vanderpoorten, R. (Univ. of Durham, Eng.). J. Phys., B (London); 8: No. 6, 926-939 (21 Apr 1975).

A local, central potential is used to describe elastic scattering of charged particles by atoms. This accounts for second-order direct and first-order exchange effects, the only parameter involved being the target dipole polarizability. Detailed values of differential, integrated elastic, and total cross sections are presented for electron-hydrogen scattering ($50 \le E \le 200$ eV) and electron-helium scattering (100 eV $\le E \le 1$ keV). Values of integrated elastic and total cross sections for positron scattering by hydrogen and helium are also given. (auth)

15503 SOME REMARKS ON THE THEORY OF COINCIDENCE EXPERIMENTS. Blum, K.; Kleinpoppen, H. (Univ. of Sterling, Eng.). J. Phys., B (London); 8: No. 6, 922-925(21 Apr 1975).

Some formulations of the theory of coincidence experiments have been reformulated in terms of density matrices, using the helicity representation, and applied to recent experiments. (auth)

15504 EXCITATION OF THE $4^2P_{\frac{1}{2}}$ LEVEL OF POTASSIUM IN COLLISIONS WITH RARE GAS ATOMS. Polarization of the Emitted Radiation. Alber, H.; Kempter, V.; Mecklenbrauck, W. (Univ., Freiburg i. B.). J. Phys., B (London); 8: No. 6, 913-921 (21 Apr 1975).

Polarization measurements have been performed on the $K(4^2P_{\frac{1}{2}}\ 4^2S_{\frac{1}{2}})$ line emitted after collisions between K and He, Ne, Ar, Kr and Xe. In all cases polarization is found in the studied lab energy range from 50 to 1500 eV; at low energies the polarization fraction is strongly dependent on collision energy. It is shown that the shape of the polarization function depends mainly on the relative population of the molecular states $A\ ^2\pi$ and $B^2\Sigma$ correlating with $K(4^2P_{\frac{1}{2}})$ + rare gas ($^1S_0$). (auth)

15505 THEORETICAL CROSS SECTIONS FOR He($1\ ^1S$) + He($1\ ^1S$) YIELDS He($1\ ^1S$) + He(s ^1P) AND He($2\ ^1S$). Olson, R. E. (Stanford Research Inst., Menlo Park, CA); Shipsey, E. J.; Browne, J. C. J. Phys., B (London); 8: No. 6, 905-912(21 Apr 1975).

The computation of total and differential cross sections for the reactions: He($1\ ^1S$) + He($1\ ^1S$) → He($1\ ^1S$) + He($2\ ^1P$) →

He(1 ^1S) + He(2 ^1S) is reported in the range E = 50 to 250 eV_{cm}. It is found that the dominant reaction is production of He(2 ^1P). The total cross sections for production of He(2 ^1S) are, at energies above 100 eV_{cm}, approximately 10% the magnitude of those for He(2 ^1P). The calculated differential cross sections compare well with the experimental data of Morgenstern et al. The calculations were carried out by generating ab initio wavefunctions and potential curves for the $X\ ^1\Sigma_g^+$, $B\ ^1\pi_g$ and $C\ ^1\Sigma_g^+$ molecular states of He_2, computing the L_y (rotational) coupling matrix elements between this set of molecular states and solving the resulting three-state quantum close-coupling problem. (auth)

15506 EXPERIMENTAL STUDY OF THE RESONANCES $2s^2\,^1S$, $2p^2\,^1D$ AND $2s2p\,^1P$ OF THE HELIUM ATOM IN ENERGY SPECTRA OF ELECTRONS EJECTED IN H^+–He COLLISIONS BELOW 150 keV. Bordenave-Montesquieu, A.; Benoit-Cattin, P.; Rodiere, M.; Gleizes, A.; Merchez, H. (Univ., Toulouse, France). J. Phys., B (London); 8: No. 6, 874-894(21 Apr 1975).

The most important experimental results concerning the $2s^2\,^1S$, $2p^2\,^1D$ and $2s2p\,^1P$ resonances of the helium atom, as observed in energy spectra of ejected electrons, are given. Characteristic parameters are obtained numerically with Shore's formula. The shape of the resonance is studied with Shore's parameter a, in the angular range 16.5° to 160° and for 33 to 150 keV proton energies; additional results concerning only the parameter q have been obtained at 10° ejection angle, down to 26 keV proton energy. The intensity of the resonances is also measured in the same angular and energy ranges, and is characterized by Shore's parameter b. The present results are compared with other experimental or theoretical works by means of the annulment diagram for the parameter a. The method permits the synthesis of all the experimental data actually available up to 500 keV. (auth)

15507 LOW ENERGY RESONANT SCATTERING OF ELECTRONS FROM MAGNESIUM. Burrow, P. D.; Comer, J. (Univ. of Manchester, Eng.). J. Phys., B (London); 8: No. 6, L92-L95 (21 Apr 1975).

Measurements have been made of low energy elastic scattering from magnesium using the electron transmission method. A large shape resonance has been observed at 0.15 eV which are identified with the $(3s^23p)\ ^2P$ state of Mg^-. The results are compared with two close coupling calculations of the scattering cross section and a model potential calculation for the shape resonance. (auth)

15508 PHASE SHIFT ANALYSIS OF ELECTRON-ATOM SCATTERING. VII. Revised 1975 Results for Mercury at Low Energies. Hutt, P. K. (Univ. of Durham, Eng.). J. Phys., B (London); 8: No. 6, L88-L91(21 Apr 1975).

A revised phase shift analysis of elastic electron-mercury scattering in the energy range below the inelastic threshold, using new polarization and differential cross section measurements of Duweke et. al. with recently recalibrated energies, is reported. It also includes momentum transfer cross section data of Rockwood. A good fit was found to all the data, with the exception of total cross sections which appear to be in error. The computed phase shifts remain in reasonable agreement with the relativistic, polarized orbital calculation of Walker at 3.5 eV, and confirm the suggestion of broad p-wave resonances around 0.7 eV. (auth)

Atomic Theory

15509 MANY-BODY EFFECTS IN ATOMIC HYPERFINE INTERACTIONS. Lindgren, I. (Chalmers Tekniska Hoegskola, Goteberg). Comments At. Mol. Phys.; 4: No. 6, 163-171(1973).

From DEAP meeting of the American Physical Society; Yale Univ. (Dec 1973).

Different perturbations of the atomic central-field model are discussed in connection with the hyperfine interaction, and various methods of calculating these effects are indicated. Results of a new many-body calculation of the hyperfine interaction in the 2p state of Li are presented and compared with experiments and previous calculations. The semi-empirical way of evaluating nuclear quadrupole moments and the Sternheimer correction are analyzed in the light of more complete calculations. (auth)

15510 PROJECTION-OPERATOR METHODS AND TIME-CORRELATION FUNCTIONS IN TWO-LEVEL ATOMS. Bose, S. K.; Ng, D. T. (Southern Illinois Univ., Carbondale). Phys. Rev., A.: 11: No. 3, 1001-1008(Mar 1975).

Zwanzig's projection operator and Mori's non-Markoffian generalized Langevin equation methods are applied to the problem of two-level atoms. Time-correlation functions of appropriate variables are calculated in a perturbation scheme. (auth)

15511 ATOM AND ION QUADRUPOLAR POLARIZABILITY BY A VARIATIONAL METHOD. Kirsch, R.; Weislinger, E. (Nancy-1 Univ., 54 (France)). Compt. Rend., Ser. A, B; 279: No. 19, 483-486(4 Nov 1974). (In French).

Quantum variational calculation of quadrupolar polarizability of free atoms and ions was reconsidered by the extension of a semi-empirical method that J. Barriol and J. Regnier then E. Weislinger proposed for determining dipolar polarizabilities. The results achieved agree with those of more complicated calculations and the suggested method can therefore easily serve users of quadrupolar polarizabilities to interpret NMR or Moessbauer effect determinations of local interactions (field gradient). (FR)

15512 HANLE EFFECT FOR MONOCHROMATIC EXCITATION. Non Perturbative Calculation for a J = 0 to J = 1 Transition. Avan, P.; Cohen-Tannoudji, C. (College de France, 75 - Paris; Ecole Normale Superieure, 75 - Paris (France). Lab, de Spectroscopie Hertzienne). J. Phys. (Paris), Lett.; 36: No. 4, L.85-L.88(Apr 1975).

Exact theoretical expressions are derived for the fluorescent light observed in a level crossing experiment performed on a $J_g = 0$ to $J_e = 1$ transition using monochromatic excitation. The effect of radiative broadening and Zeeman detuning is discussed. (FR)

15513 THEORETICAL DETERMINATIONS OF CHARGE AND SPIN DENSITIES. Freeman, A. J. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Physics; Argonne National Lab., Ill. (USA)); Ellis, D. E. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Physics). J. Phys. (Paris), Colloq.; No. 6, 3-20(1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Recent developments in the theoretical determinations of charge and spin densities in atoms, molecules and crystalline solids are reviewed. Results for selected examples of recent work in each of these areas are presented in order to illustrate the present state of the theory for both the nonrelativistic and relativistic regimes. Comparisons with such experimental data as isomer shifts, quadrupole splittings and neutron magnetic form factors are given when appropriate in order to indicate the reliability of the results obtained. (FR)

15514 LIE GROUPS IN ATOMIC SPECTROSCOPY. Judd, B. R. (Johns Hopkins Univ., Baltimore). pp 49-62 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

The role of Lie groups in atomic spectroscopy and their usefulness in treating problems of direct physical significance is discussed in a general way. Racah's analysis of the inner electronic Coulomb interaction for the f shell is outlined, and alternate schemes are briefly described. Among these are the intervention of quasi-spin, spin-up and spin-down spaces, and quasi particle factorization. An example considering spin-spin interactions between electrons is detailed. Configuration interaction and its representation by effective operators is discussed. (27 refs.) (SDF)

15515 METHOD FOR DIRECT DETERMINATION OF LOCALIZED ORBITALS. Levy, M.; Nee, T.; Parr, R.G. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 63: No. 1, 316-318 (1 July 1975).

The orthogonalized Hartree method is put forward as a method for directly determining localized orbitals in atoms and molecules. To obtain the orbitals in this method one minimizes the energy functional for a Hartree product of orthonormal orbitals. If desired, the exchange energy for these orbitals is then subtracted. It is shown rigorously that this method gives orbitals more exchange-localized than can be obtained from the Hartree–Fock method, at a small cost in total energy. Specifically, if K represents the sum of the interorbital exchanges and E the total energy (including exchange), then $0 \leqslant K^{\text{orthHartree}} \leqslant K^{\text{Hartree-Fock}}$ and $0 \leqslant E^{\text{orthHartree}} - E^{\text{Hartree-Fock}} \leqslant K^{\text{Hartree-Fock}} - K^{\text{orthHartree}}$. The Edmiston–Ruedenberg method of localization minimizes $K^{\text{Hartree-Fock}}$, and so the orthogonalized Hartree method yields a K even smaller than the Edmiston–Ruedenberg K. From numerical evidence which is presented, previous work of others, and additional arguments, it is reasoned that the orthogonalized Hartree method, without exchange energy included, may provide good predictions of conformational energy changes in molecules—it is the orthogonality of the orbitals, not the exchange energy itself, which is more important for the prediction of energy changes. The near classical structure of the equations of the orthogonalized Hartree method is discussed. (auth)

15516 QUALITY OF GAUSSIAN BASIS SETS: DIRECT OPTIMIZATION OF ORBITAL EXPONENTS BY THE METHOD

OF CONJUGATE GRADIENTS. Kari, R.E.; Mezey, P.G. (Department of Chemistry, Laurentian University, Sudbury, Ontario, Canada); Csizmadia, I.G. J. Chem. Phys. 63: No. 1, 581-585 (1 July 1975).

Expressions are given for calculating the energy gradient vector in the exponent space of Gaussian basis sets and a technique to optimize orbital exponents using the method of conjugate gradients is described. The method is tested on the (9^s5^p) Gaussian basis space and optimum exponents are determined for the carbon atom. The analysis of the results shows that the calculated one-electron properties converge more slowly to their optimum values than the total energy converges to its optimum value. In addition, basis sets approximating the optimum total energy very well can still be markedly improved for the prediction of one-electron properties. For smaller basis sets, this improvement does not warrant the necessary expense. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 15240.

15517 (SFB-MHD-16) STABILITY OF CONDUCTING PLANE AND HOLLOW JETS IN A PARALLEL MAGNETIC FIELD. Plaschko, P. (Technische Univ. Berlin (F. R. Germany). Sonderforschungsbereich Magnetohydrodynamik). Jul 1974. 127p. (In German). Dep. NTIS (US Sales Only) $9.50.

Thesis.

A theoretical study of the stability of conducting, inviscid plane and axisymmetric hollow jets in a parallel magnetic field surrounded by moving gases was performed. The linearized stability equations were deduced allowing variations of the basic flow and the material properties in the direction normal to the boundary. From them it was possible to formulate the transition conditions at a boundary between different media in a strict manner. In the limit of small magnetic Reynolds numbers the electromagnetic field is proportional and the flow field is independent of the latter. The linearization of the induced magnetic field is thereby justified. For the first time calculations were performed with spatial and temporal excitations under consideration of the influence of both MHD parameters. (auth)

15518 EFFECTS OF HOMOGENEOUS AND HETEROGENEOUS REACTIONS ON THE DISPERSION OF A SOLUBLE MATTER IN A MHD CHANNEL FLOW. Soundalgekar, V. M.; Gupta, S. K. (Indian Inst. of Tech., Bombay). Int. J. Heat Mass Transfer.; 18: No. 4, 531-535(Apr 1975).

An analysis of the dispersion of a solute in an incompressible, viscous, electrically conducting fluid flowing between two nonconducting plates, under the action of a transverse magnetic field has been carried out on the assumption of a homogeneous irreversible first-order chemical reaction and heterogeneous reaction. Expressions for the effective Taylor diffusion coefficient have been derived in both cases. It is observed that the effective Taylor diffusion coefficient decreases due to an increase in the homogeneous reaction rate constant and also due to an increase in the heterogeneous reaction at the catalytic walls. An increase in M, the Hartmann number, leads to a decrease in the effective Taylor diffusion coefficient whereas an increase in K, the loading parameter, leads to an increase in the effective Taylor diffusion coefficient. (auth)

15519 THEORY OF THE ONE-DIMENSIONAL "MIXED" STATE IN SUPERCONDUCTORS OF THE FIRST KIND. Tekiel, P. (Polish Academy of Sciences, Wroclaw). Acta Phys. Pol., Ser. A.; 47: No. 3, 339-346(1975).

The structure is explained of the "superconducting" phase's core that forms along the symmetry axis of a cylindrical superconductor of the first kind through which an electric current flows, whose intensity considerably exceeds the critical value J_c. The maximum current intensity is determined above which the "superconducting" core can no longer exist. The core is shown to be stable in the face of small perturbations, periodic along the current's direction, of the interphase boundary. (auth)

15520 CONFLUENCE OF THREE SHOCK WAVES FOR TRANSVERSE SHOCKS AND SHOCKS IN AN ALIGNED MHD FIELD. Bestman, A. R. (Univ. of Sydney). J. Plasma Phys.; 13: No. 1, 107-125(Feb 1975).

The confluence of three shock waves meeting at a point is studied, in an ideally conducting perfect gas, for transverse shocks and shocks in an aligned MHD field. The method used involves the hodograph mapping technique. A presentation of the shock polars in the total pressure P*, flow deflexion $\delta(\delta, P^*/P_0^*)$ plane is thus given. The algebraic complexity of the problem prohibits discussion of an alternative mathematical approach. (auth)

15521 ENERGY ABSORPTION IN THE CONTINUOUS SPECTRUM OF IDEAL MHD. Tataronis, J. A. (New York Univ.). J. Plasma Phys.; 13: No. 1, 87-105(Feb 1975).

The relationship between energy absorption and the continuous frequency spectrum of the linearized equations of ideal MHD is investigated, limited to incompressible fluid perturbations for which the continuum stems from resonant surfaces where the oscillation frequency equals the local frequency of an Alfven wave. Details of this absorption process are illustrated by obtaining the response of the diffuse sheet pinch to an external current source. Expressions are derived that give the rate at which energy is transferred to the plasma, and show the spatial distribution of the absorbed energy. The results indicate that the absorption is enhanced if the plasma profile has regions of large spatial gradients. This enhanced absorption is a consequence of the presence of surface waves. (auth)

15522 INSTABILITY OF THE FREE-CONVECTION TYPE IN MAGNETOHYDRODYNAMICS. Nedospasov, A.V.; Khait, V.D. (Institute of High Temperature of the USSR, Academy of Sciences, Moscow, USSR). Phys. Fluids 18: No. 7, 787-790 (July 1975).

The processes occurring in an electroconductive fluid in a magnetic field and subjected to an electric current flowing through it are discussed. In a fluid whose electrical conductivity rises with temperature, a phenomenon similar to free convection occurs when the entropy drops along the direction of the force $j \times B$. The joint action of this phenomenon and the overheating instability which also stems from the temperature dependence of the electrical conductivity and the effect of electromagnetic braking is considered. In this case, the criterion of stability is obtained. Instability in the form of free convection also appears due to a Hall current j_H flowing along the electrodes of a magnetohydrodynamic channel when a high temperature gradient occurs along the direction of the force $j_H \times B$. The instability arises near the cathode and the appearance of one is determined by the value of a dimensionless parameter identical to the Rayleigh number $Ra = (d\ln\sigma/dT)\, \tilde{g}l^4\, |\nabla T|\, /\nu\chi$ where $\tilde{g} = j_H B/\rho$ plays the role of the gravitational acceleration and $d\ln\sigma/dT$ plays the role of the expansion coefficient. (auth)

15523 NONLINEAR ANALYSIS OF MAGNETOHYDRODYNAMIC FLOW INSTABILITY. Kolesnikov, V.K.; Nedospasov, A.V.; Khait, V.D. (Institute of High Temperature of the USSR Academy of Sciences, Moscow, USSR). Phys. Fluids 18: No. 7, 791-794 (July 1975).

A nonlinear analysis is given of the oscillations of the magnetohydrodynamic flow instability caused by the dependence of the conductivity on the temperature. The effect of the flow parameters is studied. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

15524 OBSERVATION OF GRAVITATIONALLY INDUCED QUANTUM INTERFERENCE. Colella, R.; Overhauser, A.W. (Department of Physics, Purdue University, West Lafayette, Indiana 47907); Werner, S.A. Phys. Rev. Lett. 34: No. 23, 1472-1474 (9 June 1975).

We have used a neutron interferometer to observe the quantum-mechanical phase shift of neutrons caused by their interaction with Earth's gravitational field. (auth)

15525 PROGRAM PORTABILITY IN HIGH-ENERGY PHYSICS. Boeck, R. K. (European Organization for Nuclear Research, Geneva (Switzerland)). Comput. Phys. Commun.; 9: No. 4, 221-229(Apr 1975).

The computing problems in high-energy physics is discussed, and the portability achieved in software in the field is reviewed. The techniques employed at CERN for developing programs are described and suggestions put forward for the future solution of the problems of portability. (auth)

Electromagnetic

15526 DIRECT PAIR PRODUCTION BY HIGH ENERGY COSMIC RAY MUONS. Wright, A. G. (Polytechnic of North London, Eng.). J. Phys., G (London); 1: No. 3, 362-375(1 Apr 1975).

An apparatus consisting of a stack of six scintillation counters interleaved with lead target material has been operated in underground laboratories at depths below the top of the atmosphere of 72 and 460 hg cm^{-2}. The probability that a muon transferred secondary energy in the range 0.1 to 30 GeV was determined from the recorded data. At the shallower depth the dominant process was knock-on and at the greater depth direct pair production was more significant. By comparing the rates of electromagnetic interactions at the two depths it was possible to make an estimate of the contribution due to pair production which was relatively insensitive to systematic errors. For secondary energies in the range 0.1 to 5 GeV the results confirm the theoretical predictions for both knock-on and pair production to within about 15% in each case. (auth)

15527 PRELIMINARY DETERMINATION OF GYROMAGNETIC RATIO OF THE PROTON IN CHINA. K'o Hsueh T'ung Pao; No. 12, 575(1974). (In Chinese).

From September to December of 1973, an accurate determination of gyromagnetic ratio γ_p was made. By taking a mean value between the positive and reverse directions of standard field, the influence exerted by the residual field of terrestrial magnetism was cancelled out and the spherical and cylindrical specimens were compared. For more than a year, the stability of the determination device was good, and the standard error σ of determination results was less than 2×10^{-7}. The gyromagnetic ratio of the proton determined (without diamagnetic correction) was $\gamma'_p = 2.6751362\ (70) \cdot 10^8/\text{tesla}_{\text{China}} \cdot \text{second}$. (JPRS)

15528 QUANTUM NUMBERS AND DECAY WIDTHS OF THE ψ (3095). Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Feldman, G.J.; Fischer, G.E.; Fryberger, D.; Hanson, G.; Jean-Marie, B.; Larsen, R.R.; Lüke, D.; Lüth, V.; Lynch, H.L.; Lyon, D.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Rapidis, P.; Richter, B.; Schwitters, R.F.; Tanenbaum, W.; Vannucci, F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Abrams, G.S.; Briggs, D.D.; Chinowsky, W.; Freidberg, C. E.; Goldhaber, G.; Kadyk, J. A.; Litke, A. M.; Lulu, B. A.; Pierre, F. M.; Sadoulet, B.; Trilling, G. H.; Whitaker, J. S.; Winkelmann, F.; Wiss, J. E. Phys. Rev. Lett. 34: No. 21, 1357-1360 (26 May 1975).

We present cross sections for $e^+e^- \rightarrow$ hadrons, e^+e^-, and $\mu^+\mu^-$ near 3095 MeV. The ψ (3095) resonance is established as having an assignment $J^{PC}=1^{--}$. The mass is 3095 ±4 MeV. The partial width to electrons is $\Gamma_e=4.8\pm0.6$ keV and the total width $\Gamma=69\pm15$ keV. Total rates and interference measurements for the lepton channels are in accord with μ-e universality. (auth)

15529 MUON PAIR PRODUCTION BY e^+e^- ANNIHILATION AT THE 3100 MeV RESONANCE. Braunschweig, W.; Koenigs, E.; Jordan, C. L.; Martyn, U.; Sander, H. G.; Schmitz, D.; Sturm, W.; Wallraff, W. (Technische Hochschule Aachen (F. R. Germany). 1. Physikalisches Inst.); Berkelman, K.; Cords, D. Phys. Lett., B; 56: No. 5, 491-494(26 May 1975).

Results are reported for μ pair production in e^+e^- collisions at the 3100-MeV resonance. A resonance cross section integrated over total energy of 1240 ± 140 nb-MeV implying $\Gamma_{\mu\mu}\Gamma_{ee}/\Gamma_{tot} = 0.51 \pm 0.09$ keV is found. The angular distribution is consistent with $\sim(1 + \cos^2\theta)$. No forward-backward asymmetry is observed. (auth)

15530 SEARCH FOR NEUTRINO-PRODUCED MAGNETIC MONOPOLES IN A BUBBLE CHAMBER EXPOSURE. Carrigan, R. A. Jr.; Nezrick, F. A. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Nucl. Phys., B; 91: No. 2, 279-288(2 Jun 1975).

J. Schwinger has suggested that magnetically charged particles could be produced via a magnetically charged intermediate boson process similar to the mechanism sometimes envisioned for double muon production by neutrinos. A search for magnetic monopole production by neutrinos was made by reexamining the CERN heavy liquid bubble chamber pictures obtained during the neutrino exposures of 1963 and 1967. Five different searches were made for events which contained a free monopole with and without target nucleus excitation, and for bound monopoles which deexcited by photon emission. No events were found. Neutrino monopole production cross section limits are given. (auth)

15531 SEARCH FOR ELECTROMAGNETIC DECAYS OF NEUTRAL HYPERONS IN THE 1210-1500 MeV MASS RANGE AND OF NEUTRAL MESONS IN THE 150-600 MeV MASS RANGE. Colas, J.; Farwell, C.; Ferrer, A.; Six, J. (Paris-11 Univ., 91- Orsay (France)). Nucl. Phys., B; 91: No. 2, 253-265(2 Jun 1975).

K^- interactions in a heavy liquid bubble chamber were analyzed to extract proton interactions of the following types: $K^-p \rightarrow \Lambda^0\gamma\gamma$, $\Lambda^0\gamma\gamma\gamma$, $\Lambda^0\pi^0\gamma$, $\Lambda^0\pi^0\gamma\gamma$. A comparison was made with $K^-p \rightarrow \Lambda^0\pi^-$, $\Sigma^0\pi^0$ and $\Lambda^0\pi^0\pi^0$ reactions, and a systematic search was made for $\gamma\gamma$, $\pi^0\gamma$, $\pi^02\gamma$ structures in the 150 to 600 MeV mass range and $\Lambda^0\gamma$, $\Sigma^0\gamma$ structures in the 1210 to 1500 MeV mass range. Limits for $\Sigma^0 \rightarrow \Lambda^0\gamma\gamma$ and Σ^0 (1385) $\rightarrow \Lambda^0\gamma$ or $\Sigma^0\gamma$ were obtained, and a direct measurement of the mass $\Sigma^0 \rightarrow \Lambda^0\gamma$ was achieved. No resonance $\Lambda^0(1327) \rightarrow \Lambda^0\gamma$ or $\Sigma^0\gamma$ was observed at a level of $(K^-p \rightarrow \Lambda^0(1327)\pi^0)/K^-p \rightarrow \Sigma^0\pi^0) < 3\%$. (auth)

15532 CHARGE CONJUGATION INVARIANCE IN ETA′(958) $\rightarrow \pi^+\pi^-\gamma$. Grigorian, A.; Lodage, A.; Mellema, D. J.; Rudnick, F. D.; Sober, D. I.; Stork, D. H.; Ticho, H. K. (California Univ., Los Angeles (USA)). Nucl. Phys., B; 91: No. 2, 232-238(2 Jun 1975).

The charge asymmetry in the decay $\eta'(958) \rightarrow \pi^+\pi^-\gamma$ was measured using η' mesons produced in the reaction $\pi^-p \rightarrow \eta'n$ at 2.1 GeV/c incident pion momentum. A value for the asymmetry of $(-6.9 \pm 7.8)\%$ was obtained, based on 295 ± 31 events after background subtraction. This result is consistent with C invariance in this decay. (auth)

15533 PHOTOPRODUCTION OF PHI-MESONS AT SMALL T-VALUES. Behrend, H. J.; Bodenkamp, J.; Hesse, W. P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Fries, D. C.; Heine, P.; Hirschmann, H.; McNeely, W. A. Jr.; Markou, A.; Seitz, E. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Phys. Lett., B; 56: No. 4, 408-412(12 May 1975).

The reaction $\gamma + p \rightarrow \phi + p$ has been measured using a spark chamber spectrometer and a tagged photon beam in the energy range from 4.6 to 6.7 GeV. Approximately 3500 photoproduced elastic ϕ-events have been collected in the t-range between t_{min} and $t = -0.4(\text{GeV/c})^2$. Cross sections and t-distributions are presented. (auth)

15534 MUON PAIR PHOTOPRODUCTION AT 20.5 GeV. Dakin, J. T.; Kreisler, M. N.; Lopez, A. M. (Massachusetts Univ., Amherst (USA)); Bolon, C.; Luckey, D.; Martin, J. F.; Osborne, L. S.; Roth, D. G. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science); Heile, F. B.; Lyon, D. E. Phys. Lett., B; 56: No. 4, 405-407(12 May 1975).

The production of muon pairs with invariant masses from 1 to 4 GeV by 20.5 GeV bremsstrahlung radiation has been studied. The invariant mass distribution has a large deviation from the expected Bethe-Heitler shape which is attributed to the ψ (3.1 GeV). The ψ (3.1 GeV) photoproduction cross section is found at an average photon energy of 18 GeV. (auth)

15535 MULTIPLICITIES AND ANGULAR DISTRIBUTIONS IN DEEP-INELASTIC *ep* AND *en* SCATTERING. Gibbard, B.; Berkelman, K.; Garbincius, P.H.; Klinger, J.S.; Wanderer, P. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York

14850); Sadoff, A.J. Phys. Rev. D 11: No. 9, 2367-2388 (1 May 1975).

We report charged hadron multiplicities and inclusive angular distributions in deep-inelastic electron-proton and electron-neutron scattering in the kinematic range $1.4 \leq Q^2 \leq 8$ GeV^2 and $3 \leq s \leq 14$ GeV^2. At the lowest s values we observe that the *ep* mean multiplicity is somewhat less than in photoproduction. This is associated with a relative increase in one-prong events and a decrease in three-prong events. Also at low s the *en* multiplicity is lower than the *ep* multiplicity. At higher s values the *ep* and *en* multiplicities are essentially equal and independent of Q^2 at fixed s. The relative topological cross sections, the pseudorapidity distributions, and the azimuthal angle dependence are also independent of Q^2. (auth)

Weak

15536 (BNL-20015) STUDY OF NEUTRAL CURRENT INTERACTIONS IN THE BROOKHAVEN 7-FT. BUBBLE CHAMBER. Cazzoli, E. G.; Cnops, A. M.; Connolly, P. L.; Louttit, R. I.; Murtagh, M. J.; Palmer, R. B.; Samios, N. P.; Tso, T. T.; Williams, H. H. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 22p. (CONF-750307-7). Dep. NTIS $4.25.

Preliminary results are reported on the observation of neutrino induced neutral current interactions in the 7-ft. bubble chamber at Brookhaven National Laboratory. The data used were obtained from the analysis of a hydrogen exposure of 62,000 pictures and of a deuterium exposure of 68,000 pictures. The neutral current to charge current ratio for multipion final states is measured to be 0.23 ± 0.08. (auth)

15537 (COO-2114-14) MEASUREMENT OF THE K/sub L/^{0} yields $\pi^+\pi^-\pi^0$ DALITZ PLOT. Messner, R. L. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 1974. 260p. Dep. NTIS $16.00.

Thesis.

A detailed study of the spectrum for the decay K_L^0 yields $\pi^+\pi^-\pi^0$, the Dalitz plot being included. The final results of the fits indicate that a matrix element linear in Y is not adequate to describe the studied decay. The results may be taken not only as evidence for a quadratic matrix element, but they also lend support to the view that final state interactions among the three pions has a small effect upon the physical decay spectrum. Also it is believed that the relatively good agreement between the experimental data and the predictions of current algebra support the current–current type of weak Hamiltonian in hadronic decays. (JFP)

15538 (SLAC-184) STUDY OF RARE DECAYS OF THE K_L^0. Donaldson, G. J. (Stanford Linear Accelerator Center, Calif. (USA)). Dec 1974. Contract AT(04-3)-515. 101p. Dep. NTIS $5.45.

Using the SLAC K_L^0 Spectrometer Facility, the ratio $\Gamma(K_L^0 \to \pi^+\pi^-\gamma)/\Gamma(K_L^0 \to \text{all})$ to be $(6.2 \pm 2.1) \times 10^{-3}$ was measured. The rate and Dalitz plot distribution of 24 ± 10 events are consistent with CP conservation in this weak-electromagnetic decay. Also upper limits were set on the processes $K_L^0 \to \mu^+\mu^-\gamma$, $\mu^+\mu^-\pi^0$, $\pi^+\pi^-e^+e^-$, and $\pi^0\pi^+e^+\nu$. (auth)

15539 CURRENT HIGH ENERGY NEUTRINO EXPERIMENTS. Mann, A. K. (Univ. of Pennsylvania, Philadelphia). pp 187-205 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

In this review of the experimental effort regarding current high energy neutrino experiments, the flavor of the investigations is given by describing two such experiments which are indicative of the main thrust of current high energy neutrino research. These are the search for short-lived sources of neutrinos and very high energy neutrino scattering. (JFP)

15540 AN EXPERIMENTAL INVESTIGATION OF THE DECAYS $K^\pm \to \pi^0\pi^0\pi^\pm$. The Slope Parameter and its Charge Asymmetry. Smith, K. M. (Glasgow Univ. (UK). Dept. of Natural Philosophy); Booth, P. S. L.; Renshall, H. R. (Liverpool Univ. (UK)); Jones, P. B.; Salmon, G. L.; Williams, W. S. C. (Oxford Univ. (UK). Nuclear Physics Lab.); Duke, P. J.; Evans, W. M.; Hill, R. E.; Holley, W. R. Nucl. Phys., B; 91: No. 1, 45-53(26 May 1975).

The slope parameter and its charge asymmetry have been measured for the τ' decay mode of the charged K mesons. No charge asymmetry in the parameter is observed to the precision level of 1.25%, indicating the absence of CP violating transitions. The result for the slope parameter is consistent with previous measurements and taken with other results on $K_{\pi 3}$ decay modes supports the conclusion that the $\Delta I = \frac{1}{2}$ rule is not exact. (auth)

Strong (Baryon-induced)

Refer also to abstract 13721.

15541 (BNL-20255) RESONANCE DETECTION METHOD BY BACKGROUND SUPPRESSION THROUGH T-DEPENDENCE. Schreiner, W. N.; Schuebelin, P.; Turkot, F. (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1975. 16p. Dep. NTIS $4.00.

A new method to obtain greatly enhanced signal to background ratios of resonances is described. The detection of a decay product at large t from a peripherally produced resonance (transverse decay) in a trigger spectrometer and the measurement of the other decay product(s) in a vertex spectrometer allow for the observation of resonances with the background suppressed by orders of magnitude over its natural abundance. The method is useful principally in the detection of high mass resonances having two-body decay modes. (auth)

15542 (COO-1545-161) ZGS PROPOSAL: MEASUREMENT OF SPIN ROTATION PARAMETERS IN LAMBDA^0 PRODUCTION AT 12 GeV/c USING THE POLARIZED PROTON BEAM AND THE EFFECTIVE MASS SPECTROMETER. Ambats, I.; Hayes, E.; Keig, W.; Lesnik, A.; Park, D.; Romanowski, T. A.; Swallow, E. C.; Ward, C. E. W.; Winston, R. (Argonne National Lab., Ill. (USA); Chicago Univ., Ill. (USA); Ohio State Univ., Columbus (USA)). Jun 1975. 6p. Dep. NTIS $4.00.

The study of the polarization properties of LAMBDA^0's produced in pp yields LAMBDA ^{0} + X interactions at a maximum ZGS energy of 12 GeV/c is proposed. The study of the induced polarization, analyzing power, and depolarization parameter for large values of the Feynman scaling variable is considered. The physics of the experiment, experimental method, and data analysis are discussed. (JFP)

15543 (SUNI-37, pp 6) POLARIZATION IN NEUTRON–DEUTERON SCATTERING. Steinbock, M. (Univ. of Cape Town); Brooks, F. D.; van Heerden, I. J. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15544 MEASUREMENT OF PROTON POLARIZATION IN NUCLEAR REACTIONS BY DOUBLE SCATTERING. Sieminski, M. (Univ. of Warsaw); Sosnowski, M.; Zupranski, P. Nukleonika; 20: No. 3, 239-246(1975).

An apparatus for measuring the polarization of medium and low energy protons produced in nuclear reactions is described. It employs the double scattering method with proton on carbon scattering as the analyzing reaction. Details of the high efficiency polarimeter and methods of reducing experimental asymmetries are discussed. (auth)

15545 A METHOD FOR POLARIZING PROTONS BY PROTON-CHLORINE ROTATING FRAME CROSS-RELAXATION IN HIGH MAGNETIC FIELDS. Veeman, W. S.; Yannoni, C. S. (IBM Research Laboratory, San Jose, California 95193, USA). Chem. Phys. Lett.; 32: No. 3, 499-502(1 May 1975).

A new technique is demonstrated for polarizing protons in high dc magnetic fields. The method was used successfully on polycrystalline samples at an arbitrary dc magnetic field strength without recourse to rotation of the sample or cycling to low or zero field. (auth)

15546 UNIVERSALITY OF THE RATE OF GROWTH OF ALL HADRON-NUCLEON TOTAL CROSS SECTIONS IN THE RANGE 10 TO 1500 GeV/c. Ganguli, S. N. (Tata Inst. of Fundamental Research, Bombay (India)). Nucl. Phys., B; 91: No. 1, 69-76(26 May 1975).

The energy dependence of total cross section of hadron-nucleon collisions has been studied in terms of two components: the first component decreases with increasing energy of the incident hadron whereas the second component increases like ln s. The coefficient of ln s is found to be the same within 5% for $p^\pm p$, $\pi^\pm p$ and $K^\pm p$ collisions. The rate of growth of the rising component, i.e., $d\sigma/d(\ln s)$, of inelastic cross sections, deduced from σ_{tot} and σ_{el}, of pp and πp are found to be the same within 1.5 standard deviations; an attempt has been made to understand this near equality from factorization of the pomeron. (auth)

15547 AVERAGE TRANSVERSE MOMENTUM AND THE SEAGULL EFFECT. van Apeldoorn, G. W.; Blokzijl, R.; Holthuizen, D. J.; Jongejans, B.; Kluyver, J. C.; Warmerdam-de Leeuw, J. M. (Amsterdam Univ. (Netherlands). Zeeman Lab.); Metzger, W. J.; Tiecke, H. G.; Timmermans, J. J. M. (Katholieke Universiteit Nijmegen (Netherlands). Fysisch Lab.). Nucl. Phys., B; 91: No. 1, 1-11(26 May 1975).

The average transverse momentum of pions as a function of their longitudinal momentum is studied in a number of reactions produced by 4.25 GeV/c negative kaons or by 7.3 GeV/c anti-

protons on protons. The observed seagull effects are attributed to the dominance of different reaction mechanisms at different values of the longitudinal momentum of the pions. (auth)

15548 NOTE ON $F_1(1540)$ PRODUCTION IN THE REACTION $pp \to pn\pi^+\pi^+\pi^-$ AT 19GeV/c. Bakken, V.; Jacobsen, T.; Olsson, J. E.; Skjevling, G. (Oslo Univ. (Norway). Fysisk Institutt). Nucl. Phys., B; 90: No. 2, 227-232(12 May 1975).

Evidence is presented for production of the $F_1(1540)$ resonance decaying to 3π in the reaction $pp \to pn\pi^+\pi^+\pi^-$ at 19 GeV/c beam momentum, thereby establishing the assignment $I^GJ^{PC} = 1\text{-}2$. (auth)

15549 ANTIPROTON-NEUTRON ANNIHILATION IN FLIGHT: A TEST OF THE ORFANIDIS-RITTENBURG STATISTICAL MODEL. Caro, D. E.; Gold, E.; Klein, A. G.; Opat, G. I.; Wignall, J. W. G. (Melbourne Univ., Parkville (Australia). School of Physics). Nucl. Phys., B; 90: No. 2, 221-226(12 May 1975).

Inclusive and exclusive branching ratios are produced for pionic annihilations of $\bar{p}n$ in the range 450-920 MeV/c. These are compared with a statistical, linear decay model for $\bar{N}N$ annihilations proposed by Orfanidis and Rittenberg, and good agreement is found using the same parameters as those adopted in previous fits of the model to $\bar{p}p$ data. (auth)

15550 OBSERVATION OF HIGH MASS ELECTRON-POSITRON PAIRS PRODUCED IN PROTON-PROTON COLLISIONS AT THE CERNISR. Buesser, F. W.; Camilleri, L.; Di Lella, L.; Pope, B. G.; Smith, A. M. (European Organization for Nuclear Research, Geneva (Switzerland)); Blumenfeld, B. J.; White, S. N. (Columbia Univ., New York (USA)); Rothenberg, A. F.; Segler, S. L.; Tannenbaum, M. J. (Rockefeller Univ., New York (USA)). Phys. Lett., B; 56: No. 5, 482-486(26 May 1975).

In an experiment performed at the CERN Intersecting Storage Rings (ISR), 11 e^+e^- pairs of high invariant mass value (> 2.5 GeV/c^2) were observed. Of these events, 9 can be interpreted as arising from the reaction $p + p \to J(3.1) +$ anything. The cross section for this reaction is estimated and compared with the result obtained at lower center-of-mass energies. (auth)

15551 NEUTRON-PROTON ELASTIC SCATTERING FROM 10 TO 70 GeV/c. Boehmer, V.; Engler, J.; Flauger, W.; Kein, H.; Moennig, F.; Pack, K.; Schopper, H. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Babaev, A.; Brachmann, E.; Eliseev, G. Nucl. Phys., B; 91: No. 2, 266-278(2 Jun 1975).

The neutron-proton elastic differential cross section was measured for incident momenta between 10 and 70 GeV/c and for values of the momentum transfer squared between 0.1 and 2.8 $(GeV/c)^2$. The forward peak and the break at about $|t| = 1$ $(GeV/c)^2$ are very similar to corresponding pp data. (auth)

15552 INCLUSIVE pd→pX AND pn→pX CROSS SECTIONS BETWEEN 50 AND 400 GeV. Robinson, B.; Abe, K.; Carr, J.; Keyne, J.; Pagnamenta, A.; Sannes, F.; Siotis, I.; Stanek, R. (Rutgers University, New Brunswick, New Jersey 08903). Phys. Rev. Lett. 34: No. 23, 1475-1478 (9 June 1975).

We have measured inclusive cross sections for the reaction pd→pX in the region $0.15 < |t| < 0.39$ GeV^2, $100 < s < 750$ GeV^2 and $0.80 < x < 0.92$ using the acceleration ramp and deuterium-gas jet target at Fermilab. These measurements are combined with our earlier measurements of pp→pX to obtain inclusive cross sections for pn→pX. (auth)

15553 TWO PARTICLE CORRELATIONS IN THE CENTRAL REGION OF pp AND π^-p INTERACTIONS AT 100-300 GeV/c. Oh, B. Y.; Morris, W.; Parker, D. L.; Smith, G. A.; Whitmore, J.; Miller, R. J.; Phelan, J. J.; Schultz, P. F.; Voyvodic, L.; Walker, R. (Michigan State Univ., East Lansing (USA)). Phys. Lett., B; 56: No. 4, 400-404(12 May 1975).

Significant positive correlations are seen for all charge combinations of pion pairs with small rapidity separation. Joint rapidity-azimuthal correlations show that this positive correlation occurs when like (unlike) pions are produced with small (large) separation in azimuth. (auth)

15554 CHARACTERISTICS OF V^0 AND γ PRODUCTION IN *pp* INTERACTIONS AT 205 GeV/c. Jaeger, K.; Colley, D.; Hyman, L.; Rest, J. (Argonne National Labortory, Argonne, Illinois 60439). Phys. Rev. D 11: No. 9, 2405-2425 (1 May 1975).

In an exposure of the Fermi National Accelerator Laboratory 30-in. bubble chamber to a beam of 205-GeV/c protons, we have determined total and differential cross sections for the inclusive reactions $p + p \to \gamma + X$, $\pi^0 + X$, $(K^0/\bar{K}^0) + X$, $\Lambda + X$. Invariant distributions in x indicate that for γ, K^0, Λ production, scaling has set in somewhere before 69 GeV. The γ differential cross sections are consistent with the relation $d\sigma/dP_u(\pi^0) = 1/2\,[d\sigma/dP_u(\pi^+) + d\sigma/dP_u(\pi^-)]$ for all P_u, where $P_u = P_L$ or $P_\perp$. The differential cross sections for Λ and K^0 production indicate a break in the distribution at $|t - t_{min}| = 1.5$ $(GeV/c)^2$ and 0.5 $(GeV/c)^2$, respectively. The Λ polarization is found to be $-(0.25 \pm 0.26)$, consistent with zero throughout the x region. (auth)

Strong (Meson-induced)

Refer also to abstract 15078.

15555 (DESY-74/60) CONFIRMATION OF THE NEW 3,700 MeV NARROW RESONANCE IN e^+e^--COLLISIONS. Criegee, L.; Dehne, H. C.; Franke, G.; Horlitz, G.; Krechlock, W.; Knies, G.; Lohrmann, E.; Mehrgardt, H.; Schmitz, R.; Ranga Swamy, T. N. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1974. 3p. INIS.

1 fig.; 4 refs. Published in Phys. Lett., Dec 1974.

The two new, very narrow resonant states discovered at Brookhaven and SLAC were confirmed at the storage ring DORIS of DESY in e^+e^--colliding beam experiments. A fit with a constant background and a gaussian distribution to the experimental points yields the following widths (r.m.s.) and resonant masses: sigma (3,100) = 0.96 ± 0.15 MeV, m(3,100) = 3,089.5 MeV; sigma(3,700) = 1.04 ± 0.15 MeV, m(3,700) = 3,680.3 MeV. (auth)

15556 (JINR-P1-8566) STUDY OF π^{-12}C INTERACTIONS AT p = 40 GeV/c WITH THE BACKWARD PROTON EMISSION IN LAB. SYSTEM. Angelov, N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The interactions of π^--mesons with carbon, accompanied by protons emitted backward in the lab. system, have been studied by means of the 2 m propane bubble chamber exposed to 40 GeV/c π^--mesons. The structure function obtained for these protons does not contradict the concepts of its universality relative to the change of the type of incident particles and their energy. (5 tables, 2 figures) (auth)

15557 (ORO-3065) PROGRESS REPORT, 1 JULY 1974–30 JUNE 1975. (Duke Univ., Durham, N. C. (USA). Dept. of Physics). 1975. Contract AT(40-1)-3065. 35p. Dep. NTIS $4.75.

Research on measurements on pion reactions with neon, pi–p interactions, and quantum electrodynamics measurements is summarized. A number of abstracts submitted to the American Physics Society are included. (JFP)

15558 METHODICAL PROBLEMS IN THE STUDY OF ELASTIC CHANNEL OF THE π^-p-INTERACTION IN A HYDROGEN CHAMBER WITH A 3.92 GeV/c MOMENTUM. Devenski, P. A. (Higher Chemico-Technological Inst., Sofia). Bulg. J. Phys.; 1: No. 3, 263-271(1974).

Methods for estimating the losses of elastic events due to a low efficiency in the finding of events with a short proton track ≦1 cm and of such whose plane concludes a small angle with the axes of the optical chambers were improved. The automatic division of events according to reaction channels was supplemented with new criteria for elastic interactions which enable one to classify events measured with a bigger error and increase the accuracy in determining the number of elastic interactions up to 1.7 per cent. (auth)

15559 EVIDENCE FOR DOUBLE DISSOCIATION IN K^-p INTERACTIONS AT 14.3 GeV/c. Denegri, D.; Pons, Y.; Barloutaud, R.; Borg, A.; Louedec, C.; Spiro, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires); Paler, K.; Shah, T. P.; Tovey, S. N. (Science Research Council, Chilton (UK). Rutherford Lab.); Chaurand, B. Nucl. Phys., B; 91: No. 1, 54-68 (26 May 1975).

The reaction $K^-p \to K^-\pi^+\pi^-\pi^+\pi^-p$ has been studied at 14.3 GeV/c to search for evidence of the double dissociation process $K^-p \to QN^*_\eta$. In the channel $K^-p \to \bar{K}^{*0}(890)\,\pi_1^-\pi_2^-\Delta^{++}(1236)$ there is simultaneous production of low-mass enhancements in the $\bar{K}^{*0}\pi_1^-$ and $\Delta^{++}(1236)\pi_2^-$ subsystems which correspond to the $Q \to K^*(890)\,\pi$ and $N^*_\eta \to \Delta\pi$ decay modes. In this particular final state the double fragmentation system is produced with a cross section of the order of a few microbarns. The data are consistent with the factorizable pomeron exchange model of double diffractive dissociation. (auth)

15560 PERIPHERAL NUCLEON-ANTINUCLEON PRODUCTION BY 13GeV/c PIONS. Dulude, R. S.; Gaidos, J. A. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). Nucl. Phys., B; 91: No. 1, 77-87(26 May 1975).

A measurement of the cross sections for $\pi^+p \to (p\bar{n})p$ and π^-p $(\bar{p}n)p$ within the range $-t(pp) < 0.5$ $(GeV/c)^2$ corresponding to identifiable recoil protons and with mass $m(N\bar{N}) < 2.7$ GeV for unambiguous one-constraint fits yields values of 25.9 ± 1.6 μb at 13.1 GeV/c and 29.1 ± 2.5 μb at 13.2 GeV/c, respectively.

The angular distributions of $N\bar{N}$ vary strongly with m ($N\bar{N}$) and suggest high spins. The cross section for $\pi^+p \rightarrow (p\bar{p})\ \Delta^{++}$ with $t'(p\Delta) < 0.75\ (GeV/c)^2$ is $3.7 \pm 0.4\ \mu b$ and may be mediated by M1 ρ exchange. (auth)

15561 NEW DATA ON $K^-p \rightarrow K^-p$ AND $\bar{K}^0n$ AND A PARTIAL-WAVE ANALYSIS BETWEEN 1840 AND 2234 MeV CENTER OF MASS ENERGY. Hemingway, R. J.; Eades, J.; Harmsen, D. M.; Petersen, J. O. (European Organization for Nuclear Research, Geneva (Switzerland)); Putzer, A. (Heidelberg Univ. (F. R. Germany). Inst. fuer Hochenergiephysik); Kiesling, C.; Plane, D. E.; Wittek, W. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Nucl. Phys., B; 91: No. 1, 12-32(26 May 1975).

The angular distributions of the reactions $K^-p \rightarrow K^-p$ and $K^-p \rightarrow \bar{K}^0n$ have been measured at 23 incident K^- momenta between 1.136 and 1.798 GeV/c using the bubble chamber technique. These data, together with other published data on the same reactions, including K^-p polarisations, KN total cross sections, and measurements of Re f(0)/Im f(0), have been analysed in terms of partial-wave amplitudes. Resonance behaviour is confirmed for the P_{03} partial wave at 1890 MeV. The resonance parameters of the F_{15} (1915), F_{17}(2030) and G_{07}(2100) have been redetermined. No evidence has been found for new resonances coupling significantly to $\bar{K}N$ in the energy region explored. (auth)

15562 K^-p CHARGE EXCHANGE AND HYPERON PRODUCTION CROSS SECTIONS FROM 860 TO 1000 MeV/c. Jones, M.; Levi Setti, R.; Merrill, D. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.); Tripp, R. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., B; 90: No. 3, 349-383 (19 May 1975).

The K^-p reactions leading to charge exchange and hyperon final states have been studied at nine momenta between 862 and 1001 MeV/c using data from a 600 000 picture exposure of the Lawrence Berkeley Laboratory 25'' liquid hydrogen bubble chamber. Partial cross sections are determined for all final states resolved by kinematic fitting. In addition, differential cross sections are presented for the two-body final states $\bar{K}^0n$, $\Lambda\pi^0$ and $\Sigma^+\pi^-$ along with hyperon polarization angular distributions for $\Lambda\pi^0$ and $\Sigma^+\pi^-$. (auth)

15563 A STUDY OF PARTICLE SPECTRA AND MASS DISTRIBUTIONS IN THE REACTION $\pi^+ + p \rightarrow n$(FORWARD) + (2π, 4π, 6π) AT 8.4 GeV/c. Alam, M. S.; Brabson, B. B.; Galloway, K.; Mercer, R. (Indiana Univ., Bloomington (USA)); Baggett, N. V.; Fowler, E. C.; Huebschman, M. L.; Kreymer, A. E. (Purdue Univ., Lafayette, Ind. (USA)); Rogers, A. H. (Stanford Linear Accelerator Center, Calif. (USA)); Baglin, C. Nucl. Phys., B; 90: No. 3, 384-396(19 May 1975).

Results are reported on particle spectra and invariant mass distributions from the reaction $\pi^+ + p \rightarrow n$ (forward + (2π, 4π, 6π) at 8.4 GeV/c. The data were obtained with the SLAC 15-inch Rapid Cycling Bubble Chamber which was triggered by detecting fast forward neutrons interacting in downstream optical spark chambers. The main features of the data can be simulated with a Monte-Carlo program which incorporates Lorentz-invariant phase space modified by exponential transverse momentum damping on each final state particle and, in addition, takes into account the geometrical constraints and triggering requirements of the system. Resonance production in some channels is seen to deviate from background distributions. (auth)

15564 INCLUSIVE PRODUCTION OF CHARGED AND NEUTRAL SIGMA HYPERONS IN K^-p INTERACTIONS AT 14.3 GeV/c. Bardadin-Otwinowska, M.; Borg, A.; Pierre, F.; Barloutaud, R.; Louedec, C.; Spiro, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires); Chaurand, B.; Drevillon, B.; Gago, J.; Labrosse, G. Nucl. Phys., B; 90: No. 3, 397-409(19 May 1975).

Inclusive production of Σ^+, Σ^- and Σ^0 hyperons in K^-p interactions at 14.3 GeV/c has been studied and compared to Λ production. Cross sections are presented as a function of longitudinal and transverse momenta and compared to the $pp \rightarrow \Sigma^+ +$ anything data. (auth)

15565 FORWARD-BACKWARD MULTIPLICITIES IN π^+p INTERACTIONS BETWEEN 8 AND 23 GeV/c. Graessler, H.; Kirk, H.; Schulte, R. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Gensch, U.; Klabuhn, J. (Akademie der Wissenschaften der DDR, Berlin-Zeuthen (German Democratic Republic). Inst. fuer Hochenergiephysik); Hofmann, H.; Lowsky, J.; Stoecker, B. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Berger, E. L.; Counihan, M. J. Nucl. Phys., B; 90: No. 3, 461-470(19 May 1975).

The multiplicity distributions and the correlations of charged particles produced forward and backward in the centre-of-mass system are studied. The correlations are small but significant. This type of analysis shows clearly the presence of the diffractive component of the inelastic cross section, amounting to about 15% of it. It is also apparent that KNO multiplicity scaling is not satisfied. (auth)

15566 ISOTENSOR $\pi^-\pi$ PHASE SHIFTS BELOW THE ρ MASS. Baker, R. D. (Cambridge Univ. (UK). Cavendish Lab.). Nucl. Phys., B; 90: No. 2, 296-306(12 May 1975).

The results of a Chew-Low extrapolation of the reaction $\pi^+p \rightarrow \pi^+\pi^+n$ at pion beam momenta 1.4 and 1.5 GeV/c are presented. By extrapolating the $\pi^+\pi^+ \rightarrow \pi^+\pi^+$ cross section and the asymmetry of the π-π angular distribution, isotensor (I = 2) S and D waves were determined at energies up to the ρ mass. The S wave was greater than previous estimates, and the D wave roughly constant at a value of $-1\frac{1}{2}°$, much greater than the Lovelace-Veneziano prediction. (auth)

15567 THE REACTION $K^+d \rightarrow K^+\pi^+\pi^-d$ AT 4.6 GeV/c. Dunwoodie, W.; Grant, A.; Goldschmidt-Clermont, Y.; Muller, F.; Quinquard, J. (European Organization for Nuclear Research, Geneva (Switzerland)); de Jongh, G.; Tavernier, S. (Institute for High Energies, ULB-VUB, Brussels, Belgium); Cornet, P.; Dunfour, P.; Grard, F. Nucl. Phys., B; 91: No. 2, 189-218(2 Jun 1975).

In an experiment with the CERN 2 meter bubble chamber, the reaction $K^+d \rightarrow K^+\pi^+\pi^-d$ was studied at an incident K^+ momentum of 4.6 GeV/c. The cross section is $250 \pm 30\ \mu b$. A strong $K^*(892)$ signal is seen and also a broad enhancement in the Q region (M($K\pi\pi$) < 1.5 GeV) with no evidence for narrow resonances in this mass interval. The production and decay properties of these objects are studied, and comparisons made with similar reactions on protons. The properties of the angular distributions of the Q decay are very similar to those found in the related reaction on a proton target. The spin-parity of the Q system is found to be predominantly 1^+ although 2^- cannot be excluded. The $d\pi$ mass distributions show an enhancement for mass values ~2.2 GeV; however the marked asymmetry in the corresponding decay angular distribution argues against a resonance interpretation of this effect. (auth)

15568 DIFFERENTIAL CROSS SECTIONS FOR BACKWARD $\pi^-p \rightarrow n\pi^0$ FROM 2.6 TO 8 GeV/c. DeMarzo, C.; Guerriero, L.; Nicolini, C.; Posa, F.; Vaccari, E.; Waldner, F. (Bari Univ. (Italy). Istituto di Fisica); Chen, G. T. Y.; Fletcher, C. R.; Lanou, R. E. Jr.; Massino, J. T. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). Phys. Lett., B; 56: No. 5, 487-490(26 May 1975).

Differential cross sections are reported for $\pi^-p \rightarrow n\pi^0$ in the backward hemisphere at incident momenta of 2.6, 3.5, 4.3, 6.0 and 8.0 GeV/c. Less pronounced structure than some previous measurements is observed with a shallow dip displaced from that seen in π^+p elastic scattering. (auth)

15569 PRODUCTION OF γ-RAYS IN K^-p AND K^+p INTERACTIONS AT 32 GeV/c. Beilliere, P. (College de France, 75-Paris); Cochet, C.; Faccini, M.; Mosca, L.; Smadja, G.; Triantis, F. A. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires); Dujardin, C.; Schlesinger, J.; Skura, J. (Mons Univ. (Belgium)); Fenjuk, A. B. Nucl. Phys., B; 91: No. 2, 219-231 (2 Jun 1975).

Inclusive cross sections and longitudinal momentum distributions are presented for γ rays produced in K^-p and K^+p interactions at 32 GeV/c in the 4.5 m Mirabelle hydrogen bubble chamber at the Serpukhov accelerator. The average longitudinal and transverse momentum of neutral pions and the average π^0 multiplicity ${}^0\langle\eta_\pi{}^0\rangle$ is an increasing function of the number of charged prongs. (auth)

15570 STUDY OF THE ENERGY AND CHARGED MULTIPLICITY DEPENDENCE OF INCLUSIVE π^- PRODUCTION IN π^-p INTERACTIONS UP TO FERMILAB ENERGIES. Morris, W.; Oh, B. Y.; Parker, D. L.; Smith, G. A.; Whitmore, J.; Voyvodic, L.; Walker, R.; Yaari, R.; Anderson, E. W.; Crawley, H. B. (Michigan State Unit., East Lansing (USA)). Phys. Lett., B; 56: No. 4, 395-399(12 May 1975).

Using new data from 100 GeV/c π^-p interactions, the energy dependence of the invariant cross-section in the target fragmentation (central) region is found. The leading particle peak near x = +1 exhibits a width in x which becomes smaller with increasing energy and an integrated cross section which is approximately energy independent. (auth)

15571 SMALL-ANGLE π^-p ELASTIC SCATTERING MEASUREMENTS. Apokin, V. D.; Derevschikov, A. A.; Matulenko, Yu. A.; Nurushev, S. B.; Solovyanov, V. L.; Solovyov, L. F. (Go-

sudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij); Adylov, G. T.; Aliev, F. K.; Vala, K.; Vodopyanov, A. S. Phys. Lett., B; 56: No. 4, 391-394(12 May 1975).

Small angle elastic pion-proton scattering in 40 and 50 GeV/c π^- beams at Serpukhov has been measured. Analysis of the data in the Coulomb interference region yields a value for the ratio of the real to the imaginary part of the strong amplitude. (auth)

15572 STUDY OF THE A_2: AN ANALYSIS OF THE REACTION $\pi^- p \to \eta\pi^- p$ AND A MISSING-MASS SPECTRUM AT 6.0 GeV/c. Underwood, D.; Conforto, G.; Kramer[4], M.A. (The Enrico Fermi Institute and Physics Department, University of Chicago, Chicago, Illinois 60637); Key, A.W.; Mobley, R.M.; Prepost, R.; Tompkins, D.H.; Witherell, M.S. Phys. Rev. D 11: No. 9, 2345-2366 (1 May 1975).

The reaction $\pi^- p \to X^- p$, $X^- \to \eta\pi^-$, $\eta \to \gamma\gamma$ has been studied in an optical spark-chamber experiment at the Argonne ZGS (Zero Gradient Synchrotron) at a beam momentum of 6.0 GeV/c and with $0.27 \leq |t| \leq 0.42$ (GeV/c)^2. The $\eta\pi$ mass spectrum contains about 1400 events in the mass range $0.80 < M(\eta\pi) < 1.55$ GeV/c^2, and is dominated by approximately 1000 events of the type $A^-_2 \to \eta\pi^-$. No structure is discernible within the A_2 mass spectrum for an experimental resolution of 7.1 MeV/c^2 [16.7 MeV/c^2 FWHM (full width at half maximum)]. A single D-wave Breit-Wigner distribution fits the data with a high confidence level, yielding for the A_2 the parameters $M_0 = 1.323 \pm 0.003$ GeV/c^2 and $\Gamma_0 = 0.108 \pm 0.009$ GeV/c^2. The angular distribution of the decay $A_2 \to \eta\pi^-$ is analyzed and the resultant density matrix elements have the values $\rho_{11} = 0.45 \pm 0.02$, $\rho_{1-1} = 0.45 \pm 0.04$, and $\rho_{00} = 0.09 \pm 0.04$. All other elements are consistent with zero. Finally, the missing-mass spectrum in the region of the A_2 is presented. A signal of 230 events above background per 5-MeV/c^2 interval is observed at the A^2 peak, with a signal to background ratio of greater than 1:1. A single D-wave Breit-Wigner distribution together with a quadratic background fits the data well, with the parameters for the A_2 being $M_0 = 1.321 \pm 0.003$ GeV/c^2 and $\Gamma_0 = 0.104 \pm 0.009$ GeV/c^2. Both A_2 mass spectra are incompatible with dipole shape. (auth)

15573 BACKWARD $\pi^- d$ ELASTIC SCATTERING FROM 496 TO 1050 MeV/c. Keller, R.; Crabb, D.G.; O'Fallon, J.R.; Richards, T.J. (Physics Department, Saint Louis University, St. Louis, Missouri 63103); Schroeder, L.S.; Ott, R.J.; Trischuk, J.; Va'vra, J. Phys. Rev. D 11: No. 9, 2389-2399 (1 May 1975).

Measurements of the differential cross sections for $\pi^- d$ elastic scattering in the backward angular region are presented. These measurements were made at thirteen incident pion- momenta ranging from 496 to 1050 MeV/c, over the center-of-mass angular range 148° to 177°. The experiment was performed at the LBL Bevatron. Experimental apparatus consisted of a liquid deuterium target and a double- arm spectrometer which included scintillation counter hodoscopes. Center-of-mass differential cross sections were found to be generally smooth over the angular range covered and can be fitted with low-order polynomials. The extrapolated differential cross sections at 180° scattering angle were found to decrease rapidly with increasing momentum, with a prominent peak near 700 MeV/c and a shoulder near 900 MeV/c. These data are discussed in terms of existing models employing "d^*" structures, and are compared with other similar measurements. (auth)

15574 MEASUREMENT OF THE CROSS SECTION FOR THE REACTION $\pi^- p \to$ (all neutrals) FROM 4.0 TO 8.0 GeV/c. Polychronakos, V.; Cason, N.M.; Bishop, J.M.; Biswas, N.N.; Kenney, V.P.; Shephard, W.D. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556); Watson, J.M. Phys. Rev. D 11: No. 9, 2400-2404 (1 May 1975).

The cross section for the reaction $\pi^- p \to$ (all neutrals) has been measured at 4, 5, 6, 7, and 8 GeV/c. The cross section varies with beam momentum as $p_{lab}^{-1.4}$. The analysis is based on data obtained during an experiment studying the reaction $\pi^- p \to nK_1^0K_1^0$ at 6 and 7 GeV/c using the Argonne National Laboratory 1.5-meter streamer chamber. An independent value for the all-neutral cross section at 8.05 GeV/c has been obtained from an exposure in the Brookhaven National Laboratory 80-in. hydrogen bubble chamber and is quite consistent with the result from the purely electronic measurement. (auth)

15575 SPIN-PARITY ANALYSIS OF THE B MESON. Chung, S.U.; Protopopescu, S.D. (Brookhaven National Laboratory, Upton, New York 11973); Lynch, G.R.; Alston-Garnjost, M.; Barbaro-Galtieri, A.; Friedman, J.H.; Ott, R.L.; Rabin, M.S.; Solmitz, F.T.; Flatté, S.M. Phys. Rev. D 11: No. 9, 2426-2440 (1 May 1975).

We have done a J^P analysis of the low-mass $\pi^+\omega$ system, using the reaction $\pi^+ p \to \pi^+\omega p$ at 7.1 GeV/c. We find that the B resonance cannot be $J^P = 0^-$ and must belong to the unnatural-parity series (1^+, 2^-, 3^+, ...), regardless of the amount of interference between the B and the background. If we assume that the B does not interfere with the background, we find that all J^P states for the resonance are rejected except for 1^+. Even if interference effects are allowed in the analysis, a good fit with reasonable parameters is obtained only with the 1^+ hypothesis for the B meson. In an appendix, we give relevant theoretical formulas appropriate for a $\pi\omega$ system with any number of spin-parity states and arbitrary degrees of interference among them. (auth)

15576 STUDY OF THE REACTION OF THE QUASIELASTIC BACKWARD $\pi^- p$ SCATTERING BY A DEUTERON AT 3.63 GeV/c. Aref'ev, A.V.; Bayukov, Yu.D.; Efremenko, V.I.; Zaitsev, Yu.M.; Leksin, G.A.; Suchkov, D.A.; Khasanov, F.M. JETP Lett. 21: No. 4, 111-112 (20 Feb 1975).

We investigated the quasielastic backward $\pi^- p$ scattering by a deuteron at 3.63 GeV/c. Using the distributions with respect to the momentum and the cosine of the polar angle of the recoil neutron and the Treiman–Yang angle, we show that the process is described in the pole approximation. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 15106 and 15525.

15577 (BNL-20220) INCLUSIVE EXPERIMENTS IN THE TRIPLE-REGGE REGION. Paige, F. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 29 May 1975. 15p. Dep. NTIS $4.00.

The triple-Regge model is reviewed. Inclusive experiments in the triple-Regge region are suggested and discussed. (auth)

15578 (CNRS-CPT-73-P-582) THE LIGHT-STRING PICTURE OF THE VENEZIANO AMPLITUDE. Banyai, L. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Oct 1973. 13p. INIS.

Interpretation of the Veneziano amplitude in terms of a light-string and its gauge invariance are established. (auth)

15579 (COO-1428-416) ANNUAL REPORT, TASK B, JUNE 1, 1974-MAY 31, 1975. (Purdue Univ., Lafayette, Ind. (USA)). 1975. Contract AT(11-1)-1428. 27p. Dep. NTIS $4.50.

Research in high energy physics is summarized. (JFP)

15580 (COO-3285-21) RESEARCH IN THEORETICAL PHYSICS. Progress Report, April 1, 1975–August 31, 1975. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Physics). May 1975. Contract E(11-1)-3285. 12p. Dep. NTIS $4.00.

Progress of research is summarized. The report includes results from the following areas: quark models in terms of octonion fields, strong coupling approach to quantum field theory, the effect of gravitational fields on gauge theories with spontaneous symmetry breaking. (auth)

15581 (COO-3533-58) RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY. Progress Report for the Period Ending August 31, 1975. (Syracuse Univ., N. Y. (USA)). 1975. Contract E(11-1)-3533. 40p. (SU-4206-58). Dep. NTIS $5.00.

Research on elementary particle theory is summarized. A list of publications is included. (JFP)

15582 (ORO-2504-232) SEARCH FOR NEW PARTICLES IN HIGH ENERGY PHYSICS. Snow, G. A. (Paris-6 Univ., 75 (France). Lab. de Physique Theorique et Hautes Energies). 1973. 124p. (LPNHE-74/08). Dep. NTIS $9.25.

A resume is given of the properties of particles that have substantial theoretical support. The theory is related to the problem of the composition of matter. (JFP)

15583 (ORO-3992-221) RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY. Progress Report, 1974–1975. Sudarshan, E. C. G.; Ne'eman, Y. (Texas Univ., Austin (USA). Center for Particle Theory). 1975. Contract AT(40-1)-3992. 68p. Dep. NTIS $6.50.

Research on field theory models, phenomenological applications of field theory, strong interaction phenomenology, algebraic approaches to weak interactions, superdense matter, and a few related areas is summarized. Abstracts of AEC reports on this research are included. (JFP)

15584 (RL-75-054) KINEMATICAL CONSTRAINT ON DENSITY MATRIX. Formanek, J.; Franek, B. (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1975. 11p. Dep. NTIS (US Sales Only) $4.00.

The density matrix describing final state polarization in binary reactions is considered. The parametrization used for the experimental determination of the angular dependence of its elements is discussed. It is shown that one important constraint was overlooked in existing analyses. Some consequences of this constraint are briefly indicated. (auth)

15585 QUANTIZATION OF ZERO-WIDTH CLASSICAL DUAL VORTICES. Pottinger, D. E. L.; Rivers, R. J. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 26A: No. 1, 16-24 (1975).

It is suggested that the recently proposed correspondence between zero-width classical vortices and relativistic "strings" is destroyed by field quantization. (auth)

15586 TWO VERSUS EIGHT GLUONS. Krolikowski, W. (Univ., Warsaw). Acta Phys. Pol., Ser. B6: No. 2, 253-258 (1975).

Three puzzles of the quark model are discussed, formulated recently by Lipkin and answered by him on the ground of the three-triplet quark model with eight vector gluons which had, in fact, already been solved some years ago in the three-triplet quark model with two vector gluons. The lower symmetry of the latter model is sufficient to answer Lipkin's three questions but does not lead inevitably to the "symmetric quark model". (auth)

15587 DUAL THEORY. Volume I. Jacob, M. (ed.). Physics Reports Reprint Book Series. Amsterdam; North-Holland Publishing Company (1974). 404p. $26.50.

The book contained seven chapters, four of which were abstracted previously in NSA as: 29:27963, 29:06227, 31:09827, and 31:12587. Separate abstracts were prepared for three papers. (JFP)

For abstracts of individual chapters see: 15588–15590.

15588 DEVELOPMENT OF DUAL THEORY (A GENERAL INTRODUCTION). Fubini, S. (CERN, Geneva). pp 1-6 of Radiochemistry. Jacob, M. (ed.). Amsterdam; North-Holland Publishing Co. (1974).

A general survey is given of the development of dual theory emphasizing the most prominent features. (JFP)

15589 OPERATOR APPROACH TO DUAL MULTIPARTICLE THEORY. Alessandrini, V. (CERN, Geneva); Amati, D.; Le Bellac, M.; Olive, D. pp 51-127 of Radiochemistry. Jacob, M. (ed.). Amsterdam; North-Holland Publishing Co. (1974).

The multi-particle dual model is analyzed by making use of the operatorial approach. A new technique is introduced, which allows a comprehensive and simple treatment of operatorial manipulations, and is based on the underlying 0(2;1) symmetry of the dual resonance model. The multiloop unitarization program is sketched, and explicit results for the one-loop amplitudes, including their renormalization, are given. (auth)

15590 FURTHER DEVELOPMENTS IN THE OPERATOR APPROACH TO DUAL THEORY (A SUPPLEMENT TO THE PRECEDING CHAPTER). Olive, D. (CERN, Geneva). pp 129-152 of Radiochemistry. Jacob, M. (ed.). Amsterdam; North-Holland Publishing Co. (1974).

The discussion of further developments in the operator approach to dual theory includes multiloop amplitudes, the planar loop without spurious states, the dual Pomeron, dual fermion theory, and the connections with conventional field theory. (JFP)

15591 HYPERSPHERICAL POLAR ANALYSIS OF BILOCAL PARTICLE MODEL. Reilly, J. F. (Southampton Univ., Eng.). J. Phys. G: Nucl. Phys.; 1: No. 2, 159-171(21 Feb 1975).

A simple bilocal model of elementary particles is studied by a wave equation method which utilises hyperspherical polar coordinates. This is a cluster model in which two quanta are associated through the agency of a potential which is a function of the invariant square of the distance between the constituent quanta. Principal interest here is with the mass spectra which result from different types of potential, and these spectra are compared with results which have appeared in the literature. In the non-relativistic hydrogen atom, energy eigenvalues are associated with localised radial wavefunctions. The relativistic model here reveals the fact that mass spectra can be found without requirement of a totally square-integrable internal wavefunction. (auth)

15592 DIRAC HYPOTHESIS. Teller, E. (Univ. of California, Berkeley). pp 351-353 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

An attempt is made to formulate what is called the Dirac hypothesis: Each important question in physics will eventually have a solution. (JFP)

15593 ZITTERBEWEGUNG OF THE NEW POSITIVE-ENERGY PARTICLE. Kursunoglu, B. (University of Miami, Coral Gables, FL). pp 365-395 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The discussion of the master relativistic wave equation describing particles with different spins and masses covers the composite structure of the supermultiplets, electrodynamics without potentials, meson mass spectra, and parities. (JFP)

15594 PROGRESS IN LIGHT CONE PHYSICS. Preparata, G. (Univ., Rome). pp 422-428 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

A very brief review is given of the progress made in the physics of the light cone in the past year. Included are the light cone expansion, gauge invariance and the consequences of precocious scaling near threshold, the light cone description of the muon pair experiment, light cone expansions, and the assessment and exploitation of analyticity properties in both mass and energy of light cone amplitudes. (JFP)

15595 QUANTIZED RELATIVISTIC STRING AS A STRONG COUPLING LIMIT OF THE HIGGS MODEL. Gervais, J. L. (Ecole Normale Superieure, 75- Paris (France). Lab. de Physique); Sakita, B. (City Coll., New York (USA). Dept. of Physics). Nucl. Phys., B; 91: No. 2, 301-316(2 Jun 1975).

A relativistic strong coupling theory of Higgs' Lagrangian is developed. The basic idea is the same as the old strong coupling theory, i.e., the separation of collective coordinates (string coordinates in this case and rotator coordinates in the old string coupling) from meson fields. A system of a relativistic string interacting with a massive scalar and vector meson fields is obtained. In the strong coupling limit the masses of the meson fields become infinite. Therefore, it is proved that if one introduces an appropriate cut-off, the system becomes a quantized relativistic string. (auth)

15596 ON SEMI-INCLUSIVE RAPIDITY CORRELATIONS. Tataru-Mihai, P. I. Nucl. Phys., B; 91: No. 2, 359-364(2 Jun 1975).

A model-independent qualitative discussion on semi-inclusive rapidity correlations in high energy multi-particle production processes is presented. Connections with previous results on the same subject are pointed out. Finally, one discusses semi-inclusive rapidity correlations in terms of reduced rapidities. (auth)

15597 ANALYSIS OF THE MUELLER-REGGE MODEL. Feinberg, S.; Goren, Y.; Horn, D. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Nucl. Phys., B; 91: No. 2, 317-331(2 Jun 1975).

Asymptotic results of the Mueller-Regge model (MRM) are obtained in the fixed n limit and in the fixed n/Y limit. A two-component MRM is analyzed and its predictions, in particular for semi-inclusive correlations, are compared with the asymptotic expressions. The deficiencies of the various approximations are discussed. (auth)

15598 INCLUSIVE-INCLUSIVE RELATIONS. Eylon, Y. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Nucl. Phys., B; 91: No. 2, 239-252(2 Jun 1975).

Using the Bjorken-Kogut type of inclusive-exclusive relation, inclusive-inclusive relations among different inclusive processes are derived. Some of the difficulties related to the inclusive-exclusive relation and their implications on the inclusive-inclusive relations are discussed. For example, both duality diagrams and the behavior of inclusive processes in the deep-inelastic e-p scattering, indicate that the Bjorken-Kogut relation holds only for diffractive processes. The inclusive-inclusive relations provide information on the dependence of the scaling functions on the external masses. However, this information depends on the choice of scaling variable. Applying the same ideas to the Bloom-Gilman relation, relations among the structure functions of deep-inelastic electron scattering on different hadrons are derived. (auth)

15599 HIGH TEMPERATURE EXPANSION AND THE REGGEON CALCULUS. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Phys. Lett., B; 56: No. 5, 470-472(26 May 1975).

It is shown that in the framework of Reggeon calculus the use of the "high temperature expansion" may produce an accurate determination of the asymptotic behavior of total cross sections. (auth)

15600 THE ORIGIN OF A HIGH ENERGY SCALE IN THE POMERON CALCULUS. Amati, D. (European Organization

for Nuclear Research, Geneva (Switzerland)); Jengo, R. (Trieste Univ. (Italy). Istituto de Fisica Teorica). Phys. Lett., B; 56: No. 5, 465-469(26 May 1975).

The Gribov–Reggeon calculus, whose perturbative expansion is expected to converge at low energy, is known to give rise to critical phenomena at ultra-high energies. The aim is to investigate the transition between these two regimes and to determine the scale with which this transition happens. This is done by solving exactly the renormalization group equation in a model theory. The propagator shows a singularity whose position determines the scale in question. The dynamical origin of this scale—whose evaluation situates it beyond present machine energies—is discussed, and also the dual relation between the perturbative and the critical expansions. (auth)

15601 DOES THE FOURTH ψ PARTICLE EXIST AT ABOUT 4.9 GeV? Sanda, A.I.; Terazawa, H. (The Rockefeller University, New York, New York 10021). Phys. Rev. Lett. 34: No. 22, 1403-1407 (2 June 1975).

We show that, in a generalized three-triplet quark model, there can be four new fundamental vector-meson states with the photon quantum numbers. We propose that the broad peak in the total cross section for e^+-e^- annihilation into hadrons at 4.1 GeV and the narrow resonances ψ (3.1) and ψ (3.7) account for three of these. We predict, among other things, that there exists a fourth resonance ($\Gamma \sim 300$ MeV) at about 4.9 GeV with a partial width to electrons of approximately 1 keV. (auth)

15602 QUARK ANOMALOUS MAGNETIC MOMENT AND ψ PARTICLES. Khare, A. (Institute of Physics, Bhubaneswar 751007, India). Phys. Rev. Lett. 34: No. 22, 1410-1412 (2 June 1975).

Various consequences of the anomalous current introduced to explain the production and decay of the newly discovered ψ particles are discussed. In particular, it is shown that Adler's neutrino sum rule would be modified in such a way that it would not be consistent with the scaling behavior of the structure functions. (auth)

15603 APPARENT ATTRACTIVE CORRELATIONS IN RAPIDITY GAP DISTRIBUTION. Murai, N. (Westfield Coll., London (UK)). Phys. Lett., B; 56: No. 4, 351-354(12 May 1975).

Apparent attractive correlations in the distribution of rapidity gaps between adjacent particles can arise from kinematical constraints and the leading-particle effect. The crucial element in obtaining agreement with the data is the restriction of the pion production region to about half of rapidity space. (auth)

15604 ELECTROMAGNETIC PRODUCTION AND DECAY OF Ψ(3105). Geer, Kevin; Mainland, G. B.; Palmer, William F.; Pinsky, Stephen S. (Department of Physics, Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 11: No. 9, 2480-2483 (1 May 1975).

The electromagnetic production and decay of the ψ (3105) meson is shown to be consistent with the vector-meson-dominance model and the assignment of ψ to an SU(4) $J^P = 1^-$ multiplet. (auth)

Electromagnetic

Refer also to abstracts 15715 and 16156.

15605 (LBL-3874) INCLUSIVE MOMENTUM AND ANGULAR DISTRIBUTIONS FROM ELECTRON POSITRON ANNIHILATION AT root s equals 3.0, 3.8, AND 4.8 GeV. Hollebeek, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1975. Contract W-7405-ENG-48. 179p. Dep. NTIS $11.75.

Thesis.

Inclusive features of multi-hadron final states produced in the annihilations of electrons and positrons are presented. Data were taken at the colliding beam machine, SPEAR, at center-of-mass energies 3.0 GeV, 3.8 GeV, and 4.8 GeV. Reaction products were detected in an approximately 20 m^3 collection of spark chambers and counters, cylindrically arranged, in an axial magnetic field of approximately 4 KG, around the e^+e^- intersection region. Distributions of single-particle momenta and production angle and two-particle correlations are presented and compared with dynamical models. The results are in disagreement with expectations based on the successful parton–quark model of hadron structure. No generally satisfactory interpretation is available. (auth)

15606 (RL-75-070) HIGH ENERGY PHOTOPRODUCTION OF HEAVY MUON PAIRS. Scott, D. M. (Science Research Council, Chilton (UK). Rutherford Lab.). May 1975. 14p. Dep. NTIS (US Sales Only) $4.00.

The high energy photoproduction of heavy muon pairs offers another test of the parton model. The form of the cross section for the production of high transverse momentum pairs is calculated. Kinematic regions are found where the parton cross section dominates over that from Bethe-Heitler production. The contribution of high transverse momentum pairs to the symmetric cross section discussed by Jaffe is shown to lead to logarithmic scale breaking. (auth)

15607 NONLINEAR THEORY OF ELECTROMAGNETIC WAVE EXCITATION BY A RELATIVISTIC ELECTRON BEAM IN A METAL WAVEGUIDE, FILLED WITH A DIELECTRIC MEDIUM. Ibanov, S. T. (Sofia Univ.); Dolgenko, O. V.; Rukhadze, A. A. J. Phys., A (London); 8: No. 4, 585-593(Apr 1975).

The problem of nonlinear interaction of a relativistic electron beam with a bounded dielectric medium, which fills the metal waveguide is considered. General formulas for the frequency spectra and growth rates of the beam-excited electromagnetic waves as well as the expression for the threshold-wave amplitudes in the nonlinear stage of generation are obtained. The electromagnetic radiati n energy flow and the efficiency of generation for values close to the threshold saturation are calculated. (auth)

15608 HARD-PHOTON DISTRIBUTION IN RADIATIVE ELECTRON PAIR PRODUCTION. Corbo, G. (Univ., Rome). Lett. Nuovo Cim.; 12: No. 14, 557-560(5 Apr 1975).

In symmetric wide angle pair production, it is necessary to take into account radiative corrections due to emission of real hard photons. A new method has been developed in which Feynman graph contributions are obtained as computer output. The method enables study of the behavior of the differential cross sections in emitted photon variables at a fixed configuration and is general enough to be applicable to processes other than pair production. (1 figure) (SDF)

15609 UPPER LIMIT OF SINGLE PHOTON ASSOCIATED DECAY WIDTH OF ψ(3105). Iwao, S. (Kanazawa Univ., Japan). Lett. Nuovo Cim.; 12: No. 14, 519-521(5 Apr 1975).

By making use of an appropriate kinematical factor, the upper limit of single photon and pseudoscalar meson decay width of psi (3105) is estimated from the photonic diffractive production data of psi (3105) and known vector mesons. An extension of an early model for psi particles is briefly discussed. (SDF)

15610 DISPERSION INEQUALITIES AND THEIR APPLICATION TO THE PION'S ELECTROMAGNETIC RADIUS AND THE K_{l3} PARAMETERS. Okubo, S. (Univ. of Rochester, NY). pp 206-227 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The applications of a new type of dispersion relation to various problems are considered assuming that f(t) is a real analytic function of t in the entire complex t plane with a cut on the real axis as t_0 less than or equal to t less than or equal to infinity. The electromagnetic form factor of a charged pion and kaon three-body leptonic decay are considered. (JFP)

15611 $\Delta T = \frac{1}{2}$ RULE IN UNIFIED THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Shabalin, E. P. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 21: No. 1, 227-229(Jan 1975). (In Russian).

The possibility of explaining the $\Delta T = \frac{1}{2}$ rule in the framework of SU(3) X U(1) X U(1) invariant system of weakly interacting vector fields is examined. The basic properties of the scheme examined are the following. All properties of the usual four-quark scheme are preserved. Interaction of neutral currents occur in the scheme with preservation of the strangeness of hadrons. The $\Delta T = \frac{1}{2}$ rule appears directly connected with the proximity of the Cabibbo angle at 15°. The scheme can be realized without expansion of the symmetry groups of the hadrons observed. (JSR)

15612 QUASIPOTENTIAL APPROACH TO THE ELECTROMAGNETIC INTERACTION OF SPINLESS CHARGED PARTICLES. Krapchev, V. B.; Rizov, V. A.; Todorov, I. T. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Bulg. J. Phys.; 1: No. 2, 115-137(1974). (In Russian).

A recently proposed quasipotential equation is applied to the bound-state calculations for two spinless charged particles. The renormalization constant, associated with the 4-point function (and characteristic for the scalar electrodynamics) is determined from the following two conditions: The fine structure of the spectral lines is required to coincide with the one evaluated from the Breit equation. The main contribution to the Lamb shift (of order $\alpha^5 \ln\alpha^{-2}$) should be the same as the known expression for spin particles. The result for the Lamb shift calculation is obtained in a form symmetric with respect to the two masses. (auth)

15613 EFFECTIVE COULOMB POTENTIAL FOR ELECTRON SCATTERING BY NUCLEI. Garistov, V. P.; Nikolov, M. I.; Petkov, Petkov, I. Zh. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Bulg. J. Phys.; 1: No. 2, 138-149(1974). (In Russian).

High energy electron scattering on nuclei is investigated in the framework of the optical potential. Using the Dirac equation a general expression for the optical potential operator is obtained. The many-body problem is formally reduced to an equation of the Dirac type with an effective mass and momentum which are non-local, complex and energy-dependent operators. The differential cross sections at 250, 500, 700 MeV are calculated, and the results are compared with the experimental data. The charge density distribution parameters are obtained, and the total cross section is evaluated. (auth)

15614 PROCESSES $e^+e^- \rightarrow \pi^\pm$ IN VMD AND TWO PHOTON MECHANISM. Ghosh, T.; Dhara, M. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 48: No. 9, 810-815(Sep 1974).

The process $e^+e^- \rightarrow \pi^+\pi^-$ at higher energies (> 1 GeV) is discussed with new vector mesons (mass > 2 GeV) in VMD and ϵ-meson in two-photon mechanism. (auth)

15615 ELECTRON-POSITRON ANNIHILATION AND THE NEW PARTICLES. Drell, S. D. Sci. Am.; 232: No. 6, 50-62(Jun 1975).

The discussion of electron-positron annihilation and the new particles covers the four forces, quantum numbers, particle storage rings, virtual particles, particle production, the new particles, quantum electrodynamics, color and charm, and the significance of the particles. (JFP)

15616 COMPARISON OF NEUTRINO-AND ELECTRO-PRODUCED PIONS AND TESTS OF THE PARTON MODEL. Sehgal, L. M. (Technische Hochschule Aachen (F. R. Germany) 3. Physikalisches Inst.). Nucl. Phys., B; 90: No. 3, 471-483 (19 May 1975).

Recent measurements on the inclusive distribution of electroproduced pions, when interpreted in the quark-parton model, yield a determination of the parton fragmentation functions $D_u^{\pi^+}(z)$ and $D_d^{\pi^+}(z)$ with an estimated uncertainty of 15% and 40% respectively. These functions provide predictions (of comparable uncertainty) for pion multiplicities in the current fragmentation region of neutrino-induced processes. In particular it is shown that the magnitude (and possibly the rising trend) of the π^+/π^- ratio $N^{\pi^+}(z)/N^{\pi^-}(z)$ observed in $\nu+N \rightarrow \mu^-+\pi^\pm + \ldots$ can be reproduced. Predictions are made for the π^+/π^- and $\pi^0/\pi\pm$ ratios in the neutral current reactions, with special reference to the Gargamelle experiment. (auth)

15617 ELECTROPRODUCTION OF $K^+\Lambda$ AND $K^+\Sigma^0$. Bartl, A. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik); Majerotto, W. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Hochenergiephysik). Nucl. Phys., B; 90: No. 2, 285-295(12 May 1975).

An absorbed Regge model already proposed for kaon photoproduction is extended to electroproduction and describes well the recent experimental data on $K^+\Lambda$ and $K^+\Sigma^0$ electroproduction. As K exchange alone cannot account for the large unnatural parity contribution being present, either $K_B(1^+)$ or $K_A(1^{++})$ -$K_A(2^{--})$ exchange is considered in addition. (auth)

15618 ELECTRON AND MUON $\frac{1}{2}(g-2)$ FROM VACUUM POLARIZATION INSERTIONS. Barbieri, R. (Scuola Normale Superiore, Pisa (Italy)); Remiddi, E. (Bologna Univ. (Italy). Istituto di Fisica). Nucl. Phys., B; 90: No. 2, 233-266(12 May 1975).

A new method of calculating the lepton anomalous magnetic moment, combining the features of the dispersive and the mass operator approach is introduced. It is applied to the study of the contributions to the electron and muon anomalies coming from QED vertex graphs containing vacuum polarization insertions. Complete analytic results up to sixth order are given, together with partial results for the muon eighth-order mass-dependent contributions. (auth)

15619 THE INFLUENCE OF HIGH ENERGY ELECTRON RADIATION LENGTH ON THE DEVELOPMENT OF EXTENSIVE AIR SHOWERS (10^{13}-10^{18} eV). Bourdeau, M. F.; Capdevielle, J. N.; Procureur, Jacques. (Bordeaux-1 Univ., 33 - Talence (France). Lab. de Physique Theorique). Compt. Rend., Ser. A, B; 280: No. 10, 319-322(10 Mar 1975). (In French).

A decrease in the calculated value of high energy electron radiation length implies important changes in the development of the photo-electronic cascades of extensive air showers. The interpretation of experimental values of extensive air shower data in dynamic terms of high energy interaction (multiplicity, inelasticity, cross section), the estimation of the energy, and the identification of the primary cosmic particle have to be revised in function of this new value. (auth)

15620 ON THE ENERGY-IMPULSE OF THE PHOTON AND THE THERMODYNAMICAL EQUILIBRIUM CONDITION OF THE RADIATION FIELD IN A REFRACTIVE MEDIUM. Skobeltzyne, D. V. (AN SSSR, Moscow. Fizicheskij Inst.). Compt. Rend., Ser. A, B; 280: No. 9, 251-254(3 Mar 1975). (In French).

The energy-momentum of the photon that follows from the Minkowski tensor as well as from the Abraham tensor does not agree with the generalized equation of Einstein theory determining the statistical equilibrium between the radiation field in a refractive medium and a molecule. It seems that this contradiction is connected with the incompatibility of the following relations: the de Broglie relation: /F/ = h lambda on the one hand and the Einstein relation /F/ = μ /v/ = (epsilon/c^2 (c/n) on the other hand (epsilon = hν being interpreted as the energy of a wave packet). (auth)

15621 THE DEPOLARIZATION OF ELECTROMAGNETIC RADIATION IN A RANDOM MEDIUM: EVOLUTION OF THE STOKES PARAMETERS. Bourret, R. Rev. Cethedec; 11: No. 40, 65-86(1974).

By applying random perturbation theory to the propagation of electromagnetic radiation in a medium with a stochastic refractive index, explicit results are obtained for the coherency matrix and for the Stokes parameters as a function of the propagation distance and a physical parameter characterizing the medium. These results are valid in the parabolic approximation for plane wave propagation, wherein the essential restriction is only that back scattering be negligible. The final results obtained are not altered by the presence of a longitudinal electric component generated by the inhomogeneties. (auth)

15622 AN UPPER BOUND ON THE FREE ENERGY FOR CLASSICAL SYSTEMS WITH COULOMB INTERACTIONS IN A VARYING EXTERNAL FIELD. Smith, E. R. (Newcastle Univ. (Australia). Dept. of Mathematics); Penrose, O. (Open Univ., Milton Keynes (UK). Dept. of Mathematics). Commun. Math. Phys.; 40: No. 3, 197-213(Mar 1975).

3 figs.; 4 refs.

The thermodynamic limit is taken using a sequence of regions all the same shape as a given region with a specified distribution of normal field component. It is shown that with magnetostatic interactions the limiting free energy density is bounded above a term given. A physical argument suggests that this upper bound is the true thermodynamic limit, and that it takes account of demagnetization effects. Electrostatic interactions can be treated similarly. (auth)

15623 ELECTRON-POSITRON ANNIHILATION ABOVE CHARM THRESHOLD. Barbieri, R.; Koegerler, R.; Kunszt, Z. (European Organization for Nuclear Research, Geneva (Switzerland)); Gatto, R. (Rome Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 56: No. 5, 477-481(26 May 1975).

A first exploratory attempt is made of quantitatively describing in the charm scheme the behavior of $\sigma(e^+e^- \rightarrow \text{hadrons})$ in the region above charm threshold. Indications are given for the important role of ψ'' and possibly of ψ''', second and third radial excitations of ψ. (auth)

15624 MODIFIED HAN-NAMBU MODEL FOR THE e^+e^- RESONANCES. Kenny, B.G.; Peaslee, D.C.; Tassie, L.J. (Research School of Physical Sciences, The Australian National University, Canberra, Australian Capitol Territory 2600, Australia). Phys. Rev. Lett. 34: No. 23, 1482-1484 (9 June 1975).

Previous considerations of the Han-Nambu model for the new e^+e^- resonances are extended to fit current measurements: exactly two observable narrow resonances; two broad resonances, the ψ (4.1) and another predicted at ~4.9-5.3 GeV; the ψ (4.1) to comprise two components, of ordinary isospin equal to 0 and 1. (auth)

15625 CONTRIBUTION TO THE MUON ANOMALY FROM A SET OF EIGHT ORDER DIAGRAMS. Calmet, J.; Peterman, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 56: No. 4, 383-384(12 May 1975).

The value of the 18 diagrams of eighth order, containing second order vacuum polarization and scattering of light-by-light insertions is calculated, giving a value of $(111.1 \pm 8.1) \times (\alpha/\pi)^4$. It agrees with the estimate given formerly by Lautrup. (auth)

15626 SPIN-DEPENDENT DEEP INELASTIC ELECTRON SCATTERING IN AN ASYMPTOTICALLY FREE GAUGE THEORY. Ahmed, M. A. (Khartoum Univ. (Sudan)); Ross, G. G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 56: No. 4, 385-390(12 May 1975).

The logarithmic deviations from Bjorken scaling for the spin dependent structure functions of deep inelastic electron scattering in an asymptotically free gauge theory are computed. Continuations to the elastic limit and to the Regge region are also considered. (auth)

15627 A MODIFIED PARTON MODEL FOR REACTIONS WITH TIME-LIKE PHOTONS. Layssac, J.; Renard, F. M. (Montpellier-2 Univ., 34 (France). Dept. de Physique Mathematique). Phys. Lett., B; 56: No. 4, 364-366(12 May 1975).

A time-like photon is considered as a kind of mesonic state with valence + sea multipartons configurations; consequences for e^+e^- annihilation and leptons production in hadronic collisions are examined. (auth)

15628 RADIATIVE EFFECTS FOR RESONANCES WITH APPLICATIONS TO COLLIDING BEAM PROCESSES. Greco, M.; Pancheri-Srivastava, G.; Srivastava, Y. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Phys. Lett., B; 56: No. 4, 367-372(12 May 1975).

New expressions are presented for radiative corrections to colliding beam experiments in the presence of narrow resonances, including interference effects. These are applied to $\psi(3.1)$ and $\psi(3.7)$. (auth)

15629 COMMENTS ON FITS TO NUCLEON FORM-FACTOR DATA. Höhler, G.; Kiehlmann, H.D.; Schmidt, W. (Institut für Theoretische Kernphysik der Universität Karlsruhe, Karlsruhe, Germany and Institut für Experimentelle Kernphysik des Kernforschungszentrums, Karlsruhe, Germany). Phys. Rev. D 11: No. 9, 2667-2669 (1 May 1975).

Recent investigations of nucleon electromagnetic form factors are criticized, because the parametrizations belong to spectral functions which, in the neighborhood of threshold, are not compatible with the unitarity relation used in dispersion theory. (auth)

15630 A MODEL FOR THE DECAY $X^0 \to 2\pi\gamma$ BASED ON FINITE DISPERSION RELATIONS. Graham, R.H.; Ng, T. (Department of Physics, University of Toronto, Toronto, Canada). Phys. Rev. D 11: No. 9, 2653-2661 (1 May 1975).

The amplitude for the decay $X^0 \to 2\pi\gamma$ is constructed using a finite dispersion relation. The decay width and distribution are found to be consistent with recent experiment. A finite-energy sum rule analysis indicates that the coupling of the X^0 to the photon and the ρ meson, $g_{\rho X^0\gamma}$, has its quark-model value. A similar study is made of $\eta \to 2\pi\gamma$ from which it is concluded that $g_{\rho\gamma\eta}$ probably also has its quark-model value. (auth)

15631 K_L-K_S MASS DIFFERENCE AND RARE K DECAYS IN A PHENOMENOLOGICAL GAUGE MODEL. Joglekar, S.D. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 11: No. 9, 2490-2531 (1 May 1975).

We discuss the K_L-K_S mass difference and many rare decay modes of K mesons in a phenomenological unified gauge model of strong, electromagnetic, and weak interactions. The strong interactions of the system of pseudoscalar mesons which belong to 15-dimensional representation of SU(4) are described by a phenomenological Lagrangian which possesses approximate chiral SU(4) × SU(4) symmetry. The additional quantum number is charm. The weak and electromagnetic interactions are described by the Weinberg-Salam model. In general, the results are in qualitative agreement with those of the free-quark-model calculations. Results on the K_L-K_S mass difference indicate that charmed hadrons must not be very heavy. As in the quark-model calculation, we also find a surprising cancellation of the leading terms in the $K_0 \to \mu\bar{\mu}$ amplitude. The result for the $K^+ \to \pi^+ e\bar{e}$ branching ratio is in reasonably good agreement with the recent experimental result. Calculations of the branching ratios for the decays $K^+ \to \pi\nu\bar{\nu}$, $K_{LS} \to \pi^0\nu\bar{\nu}$, and $K_{LS} \to \pi^0 e\bar{e}$ are also performed. (auth)

15632 SUPPRESSED Ψ PHOTOPRODUCTION: A TEST FOR THE CHARM HYPOTHESIS. Carlson, C.E. (The College of William and Mary, Department of Physics, Williamsburg, Virginia 23185); Freund, P.G.O. Phys. Rev. D 11: No. 9, 2453-2455 (1 May 1975).

The prediction of our previous paper about the suppression of the photoproduction of a $c\bar{c}$ vector meson (c = charmed quark) is compared with recent information on the ψ particle. The theoretical foundations of the argument are closely analyzed. The predicted value $\sigma(\gamma p \to \psi p)/\sigma(\gamma p \to \rho p) \simeq 4.4 \times 10^{-4}$ [i.e., $\sigma(\gamma p \to \psi p) \simeq 7$ nb] is shown to be very different from what one would expect with the color interpretation of ψ. Preliminary experimental data seem to confirm this strong suppression of ψ photoproduction and with it the charm hypothesis (though we cannot rule out the idea that the ψ is, say, an intermediate weak boson). (auth)

Weak

Refer also to abstract 15793.

15633 (BNL-20227) VELOCITY OF THE NEUTRINO. Kalbfleisch, G. R. (Brookhaven National Lab., Upton, N. Y. (USA)). May 1975. 9p. Dep. NTIS $4.00.

The velocity of neutrinos might differ from c by about 0.1 percent due to violation of Lorentz invariance and/or CP invariance by neutrinos it was found in this study. (JFP)

15634 (ORO-3992-169) FINAL STATE INTERACTIONS WITH INELASTIC EFFECTS IN NONLEPTONIC HYPERON DECAYS. Bhamathi, G.; Raghavan, S. (Texas Univ., Austin (USA). Center for Particle Theory). 1975. 15p. (CPT-213). Dep. NTIS $4.00.

A recent work seemed to indicate that a satisfactory model using current algebra, PCAC and soft pion limit can be formulated for obtaining the S and P wave amplitudes of the nonleptonic decays of LAMBDA and SIGMA, as well as the DELTA I equals ½ rule if final state interactions are included. It is demonstrated that by including inelastic effects in the final state interactions (that is without the usual approximation of elastic unitarity) the results bring back a full circle. The disagreement between theory and experiment for the P wave amplitudes still persists, and no significant suppression of the I equals ⅜ state for the final particles can be predicted. (auth)

15635 NEUTRINO PROBLEM IN RELATION TO THE SUN'S INNER STRUCTURE. Christensen-Dalsgaard, J. (Aarhus Univ., Denmark). Astron. Tidsskr.; 7: No. 4, 153-159(1974). (In Danish).

Very large numbers of neutrinos are produced in the thermonuclear reactions in the sun's interior. These, being without mass or charge escape easily through the solar atmosphere and, on reaching the earth may, when detected, give information on the internal processes in the sun. However, measurements show that the maximum intensity of neutrino radiation from the sun is a factor six less than the calculated value. It was proposed that this discrepancy can be explained by internal thermal instability occurring in the sun's interior, resulting in convection circulation transporting ^{3}He to the center. This would result in a lowering of the temperature and a reduction of neutrino production. It is calculated that such instabilities will occur regularly with a period of about 200 million years, taking some 10 million years to recover and reestablish stable conditions. It is pointed out that the solar radiation reaching the earth would be reduced by about 5% by this mechanism and that the occurrence of ice ages on the earth can be roughly correlated to such instabilities. (JIW)

15636 THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Weinberg, S. (Massachusetts Inst. of Technology, Cambridge). pp 157-186 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The problem discussed is how to construct field theories of the weak interaction which make sense and in particular how to construct field theories in which divergences either do not appear at all or can be eliminated in a physically reasonable way. (JFP)

15637 PROSPECTS FOR THE DETECTION OF HIGHER ORDER WEAK PROCESSES AND THE STUDY OF WEAK INTERACTIONS AT HIGH ENERGY. Cline, D. (Univ. of Wisconsin, Madison). pp 228-263 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The discussion of prospects for the detection of higher order weak processes and the study of weak interactions at high energies covers lepton–lepton collisions, semi-leptonic and nonleptonic processes, and high energy neutrino scattering. (JFP)

15638 POTENTIAL DESCRIPTION OF THE SCATTERING OF ALPHA PARTICLES. Grotowski, K. (Inst. of Nuclear Physics, Krakow). Nukleonika; 20: No. 3, 213-237(1975).

The lecture given on the Louvain-Cracow Seminar of Alpha Particles Scattering is presented. The main features of the scattering of alpha particles from atomic nuclei together with some classical analogies are described, and the possibilities of their description by a potential scattering model are discussed. The potential description although successful in reproducing a limited part of experimental data fails when scattering is observed in the full angular range and in a more extended energy region. Some of these difficulties are probably due to the underparametrization and/or wrong parametrization of the potential used. Contributions of intermediate structure effects, multistep excitations, exchange and other antisymmetrization effects are probably also important. (auth)

15639 POSSIBLE IDENTIFICATION OF THE OUTGOING LEPTON IN NEUTRAL CURRENT REACTIONS. Wolfenstein,

L. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Physics). Nucl. Phys., B; 91: No. 1, 95-98(26 May 1975).

It may be possible to determine whether the outgoing lepton in muonless neutrino and antineutrino reactions is identical with the incident particle, even if the outgoing lepton is massless and has the same helicity. The possibility depends upon the presence of anti-hermitean currents, which can cause characteristic differences between neutrino and antineutrino reactions. (auth)

15640 WEAK ASYMMETRIES IN $e^+e^- \to \pi^+\pi^-$ AT HIGH ENERGIES. Lendvai, E.; Pocsik, G. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)). Phys. Lett., B; 56: No. 5, 462-464(26 May 1975).

Weak asymmetries of $e^+e^- \to \pi^+\pi^-$ are calculated in the one-photon and Z-exchange approximation for polarized incident beams. A considerable longitudinal asymmetry appears, in the Weinberg-Salam model this is about 4% (11.5%) for $\sqrt{s} = 28$ (40) GeV, $\sin^2\theta_w = 0.39$. (auth)

15641 SU(4) SYMMETRY AND NONLEPTONIC DECAYS. Iwasaki, Y. (Research Institute for Fundamental Physics, Kyoto University, Kyoto, Japan). Phys. Rev. Lett. 34: No. 22, 1407-1409 (2 June 1975).

I derive the new relation $\Lambda_-{}^0{:}\Sigma_0{}^+{:}\Xi_-{}^- = 1{:}-\sqrt{3}{:}-2$ for the S-wave amplitudes of the hyperon nonleptonic decays, assuming SU(4) 20-plet dominance for the weak interaction of current-current type. I also discuss the nonleptonic decays of charmed mesons. (auth)

15642 NONLEPTONIC DECAYS OF HADRONS AND THE $\Delta I = 1/2$ RULE. Arndt, R.A.; Roper, L.D. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). Phys. Rev. D 11: No. 9, 2471-2479 (1 May 1975).

The recent data for $K \to 2\pi$, $\Xi \to \Lambda\pi$, and $\Lambda \to N\pi$ decays are used to extract solutions for the parameters of these decays. The available $K \to 3\pi$, $\Sigma \to N\pi$, and $\Omega \to \Xi\pi$ data are not sufficient to determine the parameters of these decays. No preference is found for a $\Delta I = 1/2$ solution in any of the three analyzed decays. It may be possible to distinguish between $\Delta I = 1/2$ and $\Delta I \neq 1/2$ solutions for $\Lambda \to N\pi$ by means of a future measurement of the transverse polarization of the neutron in the $\Lambda \to n\pi^0$ decay. (auth)

15643 PARITY-VIOLATING NUCLEON-PION INTERACTION AND SIMULTANEOUS FITS TO NONLEPTONIC HYPERON DECAYS. Andrasi, A.; Eman, B.; Missimer, J.; Tadić, D. (Rudjer Bošković Institute and University of Zagreb, Zagreb, Croatia, Yugoslavia). Phys. Rev. D 11: No. 9, 2484-2489 (1 May 1975).

The parity-violating $NN\pi$ amplitude is usually determined through SU(3) sum rules relating strangeness-conserving to strangeness-changing decay amplitudes. Examination of recent simultaneous fits to strangeness-changing s- and p-wave amplitudes employing pole terms reveals that the $NN\pi$ amplitude is reduced by a factor of 3 relative to earlier sum-rule fits. Pole terms also provide a basis for extrapolation to off-mass-shell amplitudes. In one of the pole models, these amplitudes are significant and comparable with estimates based on the σ model. However, calculation of off-mass-shell potential matrix elements reveals that they contribute less than 10% to circular polarization in ^{181}Ta in two typical models of weak interactions employing neutral currents. (auth)

15644 CAN EXPERIMENTS INVOLVING $e^-e^+ \to \mu^-\mu^+$ DETERMINE WHETHER THE NEUTRAL WEAK FORCE IS A V,A INTERACTION?. Kayser, B. (Physics Section, National Science Foundation, Washington, D.C. 20550); Rosen, S.P.; Fischbach, E. Phys. Rev. D 11: No. 9, 2547-2551 (1 May 1975).

We consider whether experiments involving the reaction $e^-e^+ \to \mu^-\mu^+$ might tell us whether the neutral weak force involves V and A interactions, or S, P, and T couplings, or both. Distinctions between the physical effects produced by the different possible interactions suggest that such experiments could be decisive. (auth)

15645 CANCELLATION OF NEUTRAL $\Delta S + 0$ HADRONIC PROCESSES WITHOUT CHARMED PARTICLES. Darby, D. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 11: No. 9, 2552-2557 (1 May 1975).

The $SU_2 \otimes U_1$ gauge model of weak and electromagnetic interactions introduced by Weinberg and Salam is extended to the group $SU_2 \otimes U_1 \otimes U_1$. A natural cancellation of the effective Lagrangian for neutral strangeness-changing semileptonic processes is achieved without using charmed quarks. The additional neutral vector boson may have an arbitrarily small mass. (auth)

15646 WEAK NEUTRAL CURRENTS AND ν ($\bar{\nu}$) DISINTEGRATION OF THE DEUTERON. Singh, S.K. (Department of Physics, Aligarh Muslim University, Aligarh (U.P.) India). Phys. Rev. D 11: No. 9, 2602-2605 (1 May 1975).

A general formalism for calculating the cross section for neutrino (antineutrino) disintegration of the deuteron caused by the weak neutral currents predicted by the spontaneously broken gauge theories of Weinberg type is developed for moderate neutrino (antineutrino) energies in the MeV range. Numerical results are presented for the special case of low antineutrino energies relevant to the recent experiment of Gurr, Reines, and Sobel. (auth)

15647 RENORMALIZATION EFFECTS ON NEUTRINO-ELECTRON SCATTERING IN THE WEINBERG-SALAM THEORY OF LEPTONS. Salomonson, P.; Ueda, Y. (Institute of Theoretical Physics, Fack, S-402 20 Göteborg 5, Sweden). Phys. Rev. D 11: No. 9, 2606-2627 (1 May 1975).

The renormalization program for $\bar{\nu}_\mu$-e (or ν_μ-e) scattering is formulated in the Weinberg-Salam theory. The explicit calculation is carried out in the one-loop approximation. With the aid of the continuous-dimension regularization method, both ultraviolet and infrared divergences can be removed in the unitary gauge. Numerical results are discussed. (auth)

15648 POSSIBLE SELECTION RULES FOR THE DECAYS OF J, ψ, AND θ. Lo, S.Y. (School of Physics, University of Melbourne, Parkville, Victoria 3052, Australia). Phys. Rev. D 11: No. 9, 2628-2631 (1 May 1975).

Possible selection rules that may govern the medium weak interactions can be studied through various decay modes of J, ψ, and θ. (auth)

Strong (General)

Refer also to abstracts 15741, 16095, 16104, 16109, 16138, and 16144.

15649 (CNRS-CPT-74-P-659) RESONANCE POSITION AND REGGE TRAJECTORIES. Mandelbrojt, J. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Oct 1974. 3p. (In French). INIS.

The bootstrap mechanism is shown to be simplified for Regge-like amplitudes beyond a certain value of the energy s, because each singularity of the sum of contributions from a Regge family coincides, in projection on the s plane, with a singularity, or a limit of the singularity projections, of the overall amplitude. (auth)

15650 SUPERDENSE MATTER: NEUTRONS OR ASYMPTOTICALLY FREE QUARKS? Collins, J.C.; Perry, M.J. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge CB3 9EW, England). Phys. Rev. Lett. 34: No. 21, 1353-1356 (26 May 1975).

We note the following: The quark model implies that superdense matter (found in neutron-star cores, exploding black holes, and the early big-bang universe) consists of quarks rather than of hadrons. Bjorken scaling implies that the quarks interact weakly. An asymptotically free gauge theory allows realistic calculations taking full account of strong interactions. (auth)

15651 STATISTICAL TREATMENT OF THE AVERAGE RESONANCE WIDTH. Frautschi, S. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 91: No. 1, 125-150(26 May 1975).

Saturation of hadron scattering amplitudes by direct channel resonances implies that the average level width $\Gamma(m)$, level density $\rho(m)$, and number of open channels $N(m)$ are related by $\Gamma(m)\rho(m) = N(m)/2\pi$. From this relation and the dependence of N on ρ there results, for any given $\rho(m)$, a definite $\Gamma(m)$. It is found that: (i) A power law growth $\rho(m) \sim m^a$ results in an experimentally disfavored exponential growth of $\Gamma(m)$. (ii) The exponentially growing $\rho(m)$ of the statistical bootstrap model results in $\Gamma(m) \to$ constant. (iii) The forms of $\rho(m)$ suggested by various versions of the dual resonance model result in $\Gamma(m) \to$ constant, or decreasing to zero, or at most a power law increase. Arguments are given why $\Gamma(m) \to$ constant is the most physically reasonable choice. Studies of Ericson fluctuations in reactions such as elastic πN scattering at a few GeV offer the best hope of experimentally determining the behaviour of $\Gamma(m)$. (auth)

15652 MULTIPLICITY DISTRIBUTIONS IN A BOOTSTRAP MODEL INCLUDING MULTIPLY DIFFRACTIVE EVENTS. Morel, A. (European Organization for Nuclear Research, Geneva (Switzerland)); Petersson, B. (Geneva Univ. (Switzerland)). Nucl. Phys., B; 91: No. 1, 109-124(26 May 1975).

It is shown how to include multiply diffractive events in a bootstrap model, such that the cross section grows, but does not violate the Froissart bound. The consequences for the multiplicity distribution are exploited. Furthermore it is shown that non-asymptotic effects are important for an understanding of the correlations. A quantitative analysis is made, which shows that experimentally observable effects, connected with the multiply diffractive events, are expected at presently available energies. (auth)

15653 POMERON DECOUPLING IN INCLUSIVE MULTI-REGGE MODELS. Freeman, J. R. (Washington Univ., Seattle (USA). Dept. of Physics). Nucl. Phys., B; 90: No. 2, 307-312 (12 May 1975).

Inclusive charge conservation sum rules and naive duality are used to constrain the parameters of a multi-Regge-Mueller model with factorizable J-plane signularities including a leading pomeron trajectory (of intercept not necessarily one) and a countable number of secondary trajectories. Consistency requires the vanishing of the central coupling of particle π^+ to two pomeron trajectories, that is, for single particle π^+ spectra, the rapidity plateau must disappear! This unpalatable result may be a warning not to push oversimplified models too far; nevertheless, in two examples, a possible way of avoiding the decoupling through modification of the pomeron propagator to vanish for small rapidity separations is shown. (auth)

15654 QUARK CONFINEMENT AND SCALING STRUCTURE FUNCTIONS. Blaha, S. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Nuclear Studies). Phys. Lett., B; 56: No. 4, 373-375 (12 May 1975).

Examples of a class of four-dimensional gluon field theories of hadron binding in which the Schwinger mechanism manifestly prevents the appearance of free quarks in the physical particle spectrum are given. The deep inelastic structure functions are shown to have Bjorken scaling. (auth)

15655 A NEW INTERPRETATION OF THE ABSORPTION MECHANISM FOR HIGH ENERGY SCATTERING. Bishari, M. (Weizmann Inst. of Science, Rehovoth (Israel)). Phys. Lett., B; 56: No. 4, 355-358(12 May 1975).

A new s-channel absorption mechanism for high energy processes is proposed. A possible small dimensionless physical quantity naturally emerges. Consequently, the proposed s-channel equation can accommodate, at present energies, an elastic amplitude dominated by a simple factorizable bare pomeron pole, as in the t-channel perturbative expansion of the Gribov's Reggeon calculus in the strong coupling limit. (auth)

15656 AXIAL-VECTOR ANOMALY IN ASYMPTOTICALLY FREE THEORIES. Pi, S.; Shei, S. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 11: No. 10, 2946-2949 (15 May 1975).

We show the absence of radiative corrections to the axial-vector anomaly in non-Abelian gauge theories of strong interactions. (auth)

15657 REGGEON CALCULUS FOR THE PRODUCTION AMPLITUDE. I. Bartels, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 11: No. 10, 2977-2988 (15 May 1975).

We derive and discuss a representation of $2 \to n$ production amplitude in the multi-Regge limit which exhibits signature factors and singularity structure allowed by the Steinmann relations. We demonstrate how each term of the representation can be understood in terms of the more familiar $2 \to 2$ amplitudes, and prove that the representation can be cast into a factorizing form. (auth)

15658 REGGEON CALCULUS FOR THE PRODUCTION AMPLITUDE. II. Bartels, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 11: No. 10, 2989-3007 (15 May 1975).

A Reggeon calculus for the production amplitude is derived by using Gribov's method of analyzing hybrid Feynman diagrams. We find that, for any Reggeon diagram, the production amplitude can be written in the representation discussed in part I of this study, and each term can be evaluated according to rules which are a rather straightforward extension of Gribov's Reggeon calculus and have the same character of a nonrelativistic field theory. We briefly show how the concept of Reggeon field theory can be applied to production amplitudes. (auth)

15659 RENORMALIZATION OF DUAL MODELS. Shapiro, J.A. (Department of Physics, Rutgers, The State University, New Brunswick, New Jersey 08903). Phys. Rev. D 11: No. 10, 2937-2942 (15 May 1975).

A regularization and renormalization program for dual models in the critical dimension is discussed. The counterterms required for regularization are shown to be multiple insertions of zero-momentum dilatons. A heuristic summation of all such insertions leads to a slope and coupling-constant renormalization, and also to an intercept shift. The faults of the heuristic argument are discussed, and it is proved to lowest order and conjectured in general that the correct treatment leads to no intercept shift but only to renormalizations. (auth)

15660 ISSUES IN LARGE-ANGLE SCATTERING. Sivers, D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Ann. Phys. (N.Y.) 90: No. 1, 71-112 (Mar 1975).

We analyze phenomenologically several models for the high-energy scattering of hadrons through fixed, large angles. The emphasis is on trying to isolate and understand those aspects of hadronic forces which are important at large angles. We review the fixed-angle-lower bounds derived from analyticity and discuss how simple geometrical concepts can be used to guide our extrapolation of cross-sections away from the forward and backward peaks into the large-angle region. This extrapolation is important in understanding whether or not we need a new, hard component of the hadronic force to interpret the data. We try to isolate the important features of dual models, statistical models, and constituent models and to clarify the possibility of experimental distinction between these approaches. (auth)

15661 FLUX QUANTIZATION AND FRACTIONAL CHARGES OF QUARKS. Jehle, H. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742 and Max Planck Institut fur Physik und Astrophysik, Munchen 40, West Germany). Phys. Rev., D.; 11: No. 8, 2147-2177(15 Apr 1975).

It is shown that an electron as well as a quark may be considered as a superposition of a continuous manifold of loopforms, i.e., of alternative forms which one quantized magnetic flux loop may adopt. An analysis of the types of flux loops and of their modes of spinning and whirling gives a clue to the understanding of the relationship between a loop of an integer-charge lepton and a loop of a fractional-charge quark. It is shown that a consistent model exists which substantiates the claim that these elementary loops are the basic units of particle physics. Simple topological properties of various types of loops, and of linked pairs and triplets of loops, are shown to characterize leptons, mesons, and baryons. It is pointed out that the difference between electromagnetic, strong, and weak interactions is essentially one of the topology of interaction of flux loops. (LBS)

15662 HIGH ENERGY PHYSICS FILE 4. Some Elementary Particles May Be Strings. Green, M. (Cambridge Univ.). New Sci. (London).; 66: No. 944, 76-77(10 Apr 1975).

The origins of the dual resonance theory, in which hadrons behave in some ways like elastic strings, are explained. The properties of such strings, both in the classical and quantum context, and the incorporation of quarks into the theory, are considered. The possibility that eventually a theory of extended hadrons (which will possibly be string-like) will be incorporated in a complete scheme of the unified gauge theory type which already accounts successfully for electromagnetic and weak interactions, is discussed. (UK)

15663 HIGH ENERGY PHYSICS FILE 4. The New Energy Physics Field Theories. Llewellyn-Smith, C. (Oxford Univ.). New Sci. (London).; 66: No. 944, 74-76(10 Apr 1975).

The case for gauge theories being the basis for unifying not only the electromagnetic interactions with the weak interactions but also with the strong interactions and perhaps ultimately with gravitation also, is argued. It is shown that gauge theories may possibly explain many of the most exciting discoveries in particle physics during the past decade including the neutral neutrino current, the new psi particles and the mysterious properties of quarks. (UK)

Strong (Baryon No. = 0)

Refer also to abstract 15549.

15664 (DESY-75/14) TWO-BODY HADRONIC DECAYS OF THE 3.1 GeV RESONANCE. DASP-Collaboration. (Deutsches Elektronen-Synchrotron(DESY), Hamburg (F. R. Germany)). May 1975. 12p. Dep. NTIS (US Sales Only) $4.00.

Hadronic two body decays of the 3.1-GeV resonance were measured, and the following branching ratios were obtained: $\Gamma_{\pi^+\pi^-}/\Gamma_{\mu\mu} < 0.0046$, $\Gamma_{K^+K^-}/\Gamma_{\mu\mu} < 0.0084$, and $\Gamma_{p\bar{p}}/\Gamma_{\mu\mu} = 0.036 \pm 0.010$ assuming the $p\bar{p}$ decay distribution is $\sim 1 + \cos^2\theta$. (auth)

15665 INTERPRETATION OF THE NEGATIVE CORRELATION OBSERVED BETWEEN THE NUMBERS OF NEUTRAL AND CHARGED PIONS PRODUCED IN ANTI pp ANNIHILATIONS. Figiel, J. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., Ser. B6: No. 2, 249-251(1975).

Using the statistical model for charge branching ratios it is shown that the difference between the positive correlation between the numbers of charged and neutral pions produced in high energy nonannihilation processes and the corresponding negative correlation for annihilation processes just reflects the fact that the prong number distribution in annihilation processes is much narrower than in nonannihilation ones. (auth)

15666 COLOR VS. CHARM. Kitakado, S.; Walsh, T. F. (Deutsches Elektronen-Synchrotron DESY, Hamburg). Lett. Nuovo Cim.; 12: No. 14, 547-551(5 Apr 1975).

Classification of psi (3.1) and psi (3.7) in the color and charm schemes is described and their levels illustrated. Inclusive

spectra, chain and radiative decays of the lowest levels in e^+e^- are discussed in the context of the charm and color models. (1 figure) (SDF)

15667 BARYON–ANTIBARYON BOUND-STATE MODEL OF THE NEW NARROW RESONANCES. Heusch, C. A. (Max Planck Inst. fuer Physik und Astrophysik, Munich). Lett. Nuovo Cim.; 12: No. 14, 552-556(5 Apr 1975).

The baryon–antibaryon bound state is investigated as a unique system in which annihilation processes can be defined and their consequences, specifically, predictions for the final state hadrons, can be observed. Annihilation processes through third order are considered and their graphs analyzed. The implications for the interpretation of the psi states are discussed. (3 figures) (SDF)

15668 PHENOMENOLOGICAL APPROACH TO PSI(3.1)-PARTICLE. Iwao, S.; Shako, M. (Kanazawa Univ., Japan). Lett. Nuovo Cim.; 12: No. 14, 513-518(5 Apr 1975).

A phenomenological analysis is made of the properties of the psi(3.1) by assuming its quantum number to be 1^{--} and its decay an electromagnetic one. In particular, interference effects between lowest order QED and sharp resonance amplitudes near the peak cross section and the implication of other 1^{--} states close to 3.1 GeV in mass are considered. Decay rates and form factors are discussed. (2 figures, 1 table) (SDF)

15669 ARE ANNIHILATION PROCESSES STATISTICAL. Lo, S. Y. (Univ. of Melbourne). Lett. Nuovo Cim.; 12: No. 14, 542-544(5 Apr 1975).

A method for testing a statistical model for nucleon-antinucleon annihilation processes by examining only the inclusive spectrum of charged particles is proposed. It is shown how the test might be applied to a specific one cluster statistical model. (SDF)

15670 THERMODYNAMICS AND STATISTICAL MECHANICS OF THE CP VIOLATION. Ne'man, Y.; Aharony, A. (Tel-Aviv Univ., Israel). pp 397-410 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The necessity of the assumption of time reversal symmetry in the proofs of both the H theorem and the Onsager relations is investigated in relation with the system of neutral kaons. The master equation description of the neutral kaon system, the H theorem, the stationary state and Onsager relations, and the arrows of time are discussed. (JFP)

15671 CHARGE COEFFICIENTS OF A LINEAR MESON CASCADE WITH ISOSPIN CONSERVING DECAYS. Jasselette, P.; Vandermeulen, J. (Liege Univ.). Bull. Soc. R. Sci. Liege; 43: No. 11-12, 625-643(1974).

The coefficients relative to the different charge configurations in a system of N π mesons with total isospin 0 and 1 are studied. The problem is particularized to a model where the final state results from a linear sequence of emissions with conservation of the isospin throughout the sequence. The charge coefficients are calculated for each multiplicity up to N = 20. An application is made to the nucleon-antinucleon annihilation reaction. (tr-auth)

15672 THE ORTHOCHARMONIUM STATES FROM GENERALIZED VECTOR DOMINANCE. Gounaris, G. J.; Manesis, E. K. (Ioannina Univ. (Greece)); Verganelakis, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 56: No. 5, 457-461(26 May 1975).

From GVD, local duality, asymptotic U(4) symmetry, and the assumption that the 3.1-, 3.7-GeV states are bound charmed quarks, their $\Gamma_e\Gamma_h/\Gamma$ ratios are predicted. Their small hadronic widths are attributed to the low intercept of the ϕ_c^- trajectory. The equation $\sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-) = 4.1 \pm 0.3$, should be established for $\sqrt{s} \gtrsim 7$ GeV. (auth)

15673 MOVING DAUGHTER REGGE TRAJECTORIES IN THE VAN HOVE MODEL WITH SL(2, C) ⊗ SL(2, C) SYMMETRY. Ahmed, K. (Department of Physics, University of Islamabad, Islamabad, Pakistan); Qadir, A.; Arif-uz-Zaman. Phys. Rev. D 11: No. 9, 2647-2652 (1 May 1975).

A Van-Hove-type model with SL(2, C) ⊗ SL(2, C) symmetry is constructed for the elastic scattering of pseudoscalar bosons. Reggeization in the complex plane of the principal quantum number of the little group O(4) is performed. Two Lorentz pole trajectories with opposite "Lorentz signatures" and opposite intrinsic parities are shown to give rise to moving Regge daughters without the explicit introduction of unitarity. This result is independent of the choice of 4-momentum squared or the mass squared in the numerator of the spin-1 propagator. The results are the same in the equal-mass case as well. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 15463, 15730, 15733, 15974, 16100, and 16143.

15674 (TRI-74-2) LOW ENERGY (0-250 MeV) PION-NUCLEON PHASE-SHIFT FITS. Salomon, M. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Dec 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

A theoretical function is fitted to the experimental values of the phase shifts of the πN interaction by means of a standard least squares fit code. The main purpose of this parametrization is to provide a simple analytical expression of the scattering amplitude. This then can be used in impulse approximation calculations of complex nuclei, in the evaluation of approximate potentials of the πN interaction, and in the calculation of dispersion integrals. (JFP)

15675 PROTON STRUCTURE AND ITS HIDDEN CHARM. Jacob, M. (European Organization for Nuclear Research, Geneva). Phys. Bull. (London); 26: 175-181(Apr 1975).

A review is given of theoretical and experimental investigations which are currently being undertaken in an endeavor to discover whether the proton is the fundamental elementary constituent of the nucleus or whether it has a structure of its own in terms of still more fundamental and elementary entities. The hadron particles (quarks, pseudoscalar mesons, symmetry, the quark model), partons (deep inelastic electron scattering, large transverse momentum phenomena), unification of all interactions (weak neutral currents, gauge theories), and charm in particle physics, are discussed. (UK)

15676 ANTIKAON–NUCLEON SCATTERING AT LOW ENERGIES. Krzyzanowski, W. (Univ., Warsaw); Wrzecionko, J.; Wycech, S. Acta Phys. Pol., Ser.; B6: No. 2, 259-271(1975).

A separable, quasirelativistic, potential model is used to describe $\bar{K}N$ elastic and inelastic scattering. Free parameters of the model are set to reproduce the scattering data up to 300-MeV/c momentum and the virtual $Y_0(1405)$ bound state energy and width. Various inelastic processes occurring below the $\bar{K}N$ threshold and observed in the kaon nuclear interactions are studied. The dependence on the phenomenological parameters is discussed. (auth)

15677 TEST OF DUALITY DIAGRAM PREDICTIONS FOR RESONANCE BACKGROUND. Dickey, J. O. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., B; 90: No. 3, 501-520(19 May 1975).

Duality diagrams relate the backgrounds in different meson-baryon channels, after subtraction of all resonances. One such prediction, $K^+p \to \pi^+p$ (background), works remarkably well experimentally. In other channels with less complete experiments, future phase-shift analyses will now be able to calculate the background instead of fitting it. This should greatly improve the determination of Y* resonances. (auth)

15678 A COMPUTATION OF ADLER'S β SUM RULE. II. Bijtebier, J. (Brussels Univ. (Belgium)). Nucl. Phys., B; 91: No. 1, 179-188(26 May 1975).

The previous calculation of Adler's β sum rule is improved by including the Born contributions to the πN states. The result is that the sum rule is only balanced if the weak axial nucleon form factor $g_A(q^2)$ and the strong pion-nucleon form factor have roughly the same q^2 dependence. (auth)

15679 MODELS WITH RISING CROSS SECTIONS AND THE INVERSE AMPLITUDE SUM RULES. Wit, R. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Nucl. Phys., B; 91: No. 1, 88-94(26 May 1975).

Models for pion-nucleon scattering with rising cross sections are analyzed using dispersive sum rules which are valid for the inverse of the scattering amplitude. The validity of these sum rules is intimately connected with the positivity of IM T(s,t = 0). A numerical analysis shows that some of the models have difficulties when analytically continued into the complex energy plane. (auth)

15680 ON THE SIGMA TERM IN K-N SCATTERING. Harnois, J.-Y. (Toronto Univ., Ontario (Canada). Dept. of Physics). Phys. Lett., B; 56: No. 4, 379-382(12 May 1975).

By keeping the kaon on the mass shell, we derive low-energy relations constrained by the kaon-nucleon sigma term. From one of these relations, a threshold calculation shows that the sigma term depends strongly on $g_{KN\Sigma}$ only, thus allowing a reliable estimate of the sigma term. (auth)

15681 SYSTEMATICS OF VECTOR MESON-PROTON SCATTERING. Halzen, F.; Kajantie, K. (Wisconsin Univ., Madison (USA). Dept. of Physics). Phys. Lett., B; 56: No. 4, 347-350 (12 May 1975).

The systematics of Vp scattering (V = ρ, ω, ϕ, ψ) is studied using unitarity to relate the elastic and inelastic amplitudes. Assuming that ϕ and ψ are pure strange and charmed quark states, respectively, ϕp and ψp elastic amplitudes are shown, in the first approximation, to be generated by diffractive inelastic states. This leads to approximate relations for the elastic differential cross section slopes. The approximate m_V^2 suppression of the total cross section is related to a similar suppression in inelastic Vp cross sections and, more speculatively, to the m_A^2 suppression of the hadronic production cross sections σ(pp → A). (2 figures) (auth)

15682 PERSISTENCE OF FORWARD STRUCTURE IN $\pi^- + p \to \pi^0 + n$ UP TO 100 GeV/c: A POSSIBLE NEW ABSORPTION PHENOMENON. Desai, B.R. (University of California, Riverside, California 92502); Stevens, P.R. Phys. Rev. D 11: No. 9, 2449-2452 (1 May 1975).

$\pi^- p \to \pi^0 n$, the persistence of the dip a t=0 in $d\sigma/dt$ up to $p_{lab} = 100$ GeV/c and a lower $\alpha_{eff}(t = 0)$ above 20 GeV/c indicate an absorption effect in the nonflip amplitude due to peripherally produced nonelastic diffractive intermediate states whose total contribution, when summed with the triple-Regge technique, is $s^\alpha \ln(\ln s)$ for large s and small t. An excellent description of small-t data from 5 to 100 GeV/c is obtained. (auth)

15683 CONTRIBUTION OF SL(2, C) ⊗ SL(2,C) POLES TO SCALAR BOSONS AND πN SCATTERING AMPLITUDES. Arif-uz-Zaman (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 11: No. 9, 2632-2646 (1 May 1975).

An SL(2, C) ⊗ SL(2, C) -symmetric model for calculating direct-channel pole diagrams for $\pi_1\pi_2 \to \pi_1\pi_2$ and $\pi N \to \pi N$ is given. The angular dependence of the scattering amplitudes comes out in the form of O(4) rotation matrices. In order to include all angular momentum states of O(4) multiplets, intermediate particles of even and odd intrinsic parities have been introduced. Certain expressions of O(4) rotation matrices and their connections with the Gegenbauer polynomials are given in the Appendix. (auth)

15684 MODELS FOR HADRON-HADRON SCATTERING AT HIGH ENERGIES AND RISING TOTAL CROSS SECTIONS. Kang, K. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510, and Brown University, Providence, R. I. 02912); Nicolescu, B. Phys. Rev. D 11: No. 9, 2461-2465 (1 May 1975).

The recent results of rising total cross sections for $\pi^\pm p$, $K^\pm p$, and pp scattering are analyzed by two simple analytic models for high-energy forward scattering which are derived from analyticity, crossing symmetry, and the unitarity constraints of the rigorous results. The numerical fit to the data for $p_L \geq 10$ GeV/c does not rule out the possibility that the crossing-odd amplitude may not be negligible at high energies. (auth)

15685 SPIN CONTENT OF CROSSED-CHANNEL CONTRIBUTIONS AND INTERIOR DISPERSION RELATIONS. Jacob, R.J. (Department of Physics, Arizona State University, Tempe, Arizona 85281); Hite, G.E. Phys. Rev. D 11: No. 9, 2466-2470 (1 May 1975).

A method of using interior dispersion relations is presented to measure the relative importance and spin content of crossed-channel contributions to two-body scattering amplitudes in the physical region. As an illustration of the method, the $B^{(-)}$ amplitude of πN scattering is considered. It was found that in the physical region this amplitude receives contributions essentially only from the two lowest crossed-channel spin states. The higher of the two states (J = 3) was found to be adequately described by the g (1680) meson, while the lower (J = 1) could not be described by the ρ (760) meson alone, but could be described by a sum of the ρ (760) and the ρ′ (1600) meson. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 15997.

15686 (CNRS-CPT-74-P-663) SIXTEEN RELATIONS BETWEEN OBSERVABLES IN NUCLEON–NUCLEON SCATTERING. Bourrely, C.; Soffer, J. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Nov 1974. 6p. INIS.

Assuming all the usual invariance properties (parity, time reversal, identical particles) in p-p elastic scattering, twenty-five independent observables are available if one can detect the spin of each particle in all possible configurations. Since the scattering matrix depends upon nine real functions of s and t, up to an overall phase, one expects sixteen independent relations between the observables. To derive these relations, a simple method is given which is valid for any scattering process. (auth)

15687 (USIP-74-24) STRANGE PARTICLE CROSS SECTIONS IN 19 GeV/c PROTON–PROTON INTERACTIONS AND THEIR INTERPRETATION IN THE KNO FRAMEWORK. Alpgard, K.; Breivik, F. O.; Ekspong, G. (Stockholm Univ. (Sweden). Fysiska Institutionen). Nov 1974. 27p. Dep. NTIS $4.50.

Cross sections were determined for strange particle production in proton–proton interactions at 19 GeV/c, particularly for the pairs $(K^0\overline{K}^0)_{C=+1}$, $K^0\Lambda$, $K^+\Lambda$ for different prong classes. The (KK) and (KY) and the total strange particle cross sections were found to be 1.46 ± 0.14 mb, 2.73 ± 0.23 mb and 4.3 ± 0.3 mb respectively. The charged multiplicity distributions for events with K^0_s, Λ, $(K^0\overline{K}^0)_{C=+1}$ or $K^0\Lambda$ are shown to follow a modified KNO-curve. This is not true in the $K^+\Lambda$ case. The relation between the dispersion and the mean charged multiplicity is found to have the same linear relation as the overall inelastic pp-reactions. For $(K^0\overline{K}^0)_{C=+1}$, $K^0\Lambda$ and for Λ events the average charged multiplicity for the remainder system when the strange particle part has been removed, has the same behavior as systems with the same quantum numbers but obtained in collisions at corresponding beam momenta. (auth)

15688 COULOMB EFFECTS IN THE $^3He \to d + p$ VERTEX. Borbely, I. (Central Research Inst. for Physics, Budapest). Lett. Nuovo Cim.; 12: No. 14, 527-530(5 Apr 1975).

The vertex constant for $^3He \to d + p$ is determined, taking into account the Coulomb interaction in the vertex, and new results concerning the $t \to d + n$ vertex constant are presented. Experimental data for d(d,n)^{3}He and d(d,p)t are analyzed using the singularity subtraction method. (1 table) (SDF)

15689 SHORT-RANGE ANN CORRELATIONS AND THE Λ-PARTICLE BINDING IN NUCLEAR MATTER. Daniluk, A. (Teachers Coll., Siedlce, Poland); Dabrowski, J. Acta Phys. Pol., Ser.; B6: No. 2, 317-322(1975).

The contribution of the short-range ΛNN correlations to the binding energy of a Λ-particle in nuclear matter, $B_{\Lambda 3}$, is calculated with the help of the simplified method applied originally by Moszkowski in the pure nuclear matter problem. For the recent phenomenological ΛN potentials of Herndon and Tang, one obtains $B_{\Lambda 3} \simeq -4$ MeV. (auth)

15690 TESTS OF CHARGE INDEPENDENCE BY NUCLEON-NUCLEON SCATTERING. Breit, G. (State Univ. of New York, Buffalo). pp 429-440 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

A discussion is given of the related improvement of the tests of the charge independence of the long range nucleon–nucleon interactions and of the possible existence of coupling of mesonic origin between states with the same orbital quantum number but different values of the isospin and ordinary spin quantum numbers. Such coupling could conceivably affect the phase shift analysis of n–p scattering data and hence also conclusions regarding long range charge independence. (JFP)

15691 A DIFFRACTIVE MODEL INCLUDING SPIN FOR pp ELASTIC SCATTERING AT VERY HIGH ENERGY. Bourrely, C.; Soffer, J. (Centre National de La Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique); Wray D. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 91: No. 1, 33-44(21 May 1975).

In this paper a theoretical diffractive model is presented for spin-dependent proton-proton scattering at very high energies using an extended version of the Chou-Yang model. The model describes a wide t range, but in this paper it is used for small t values. Estimates are obtained of the ratio of spin-dependent to spin-independent amplitudes, β, consistent with a previous phenomenological analysis. Next the asymmetry, Σ, expected in a certain polarized inclusive process at high energy is estimated. Then the size of polarization effects in pp total cross-section measurements, using polarized beam and target at very high energy is computed. The estimates of the latter two quantities indicate that their measurement would not provide a sensitive test of pomeron factorization. (auth)

15692 THE SOFT WAY TO HARD PHOTONS: RELATIVISTIC CORRECTIONS IN PROTON-PROTON BREMSSTRAHLUNG. Fortes, M. (Niels Bohr Institutet, Copenhagen (Denmark)); Jackson, A. D.; Nyman, E. M. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., A; 242: No. 3, 493-506(5 May 1975).

Relativistic corrections to the dynamics of the strong interaction in proton-proton bremsstrahlung are studied. Relativistic field theory, solved using the ladder-approximated Bethe-Salpeter equation, is used as an underlying exact theory. It is found that relativistic corrections can be avoided altogether in the soft-photon limit. The hard-photon case requires a study of exact and approximate off-shell T-matrices. It is found, by direct

numerical calculations, that the Lippmann-Schwinger (Schrödinger) equation yields an accurate approximation to the off-shell Bethe-Salpeter T-matrix, provided that agreement be enforced on the energy shell (the soft-photon limit) and that the interaction be of the same type as in the underlying relativistic theory. The Blankenbecler-Sugar and Gross equations were also studied, but do not represent an improvement over the Lippmann-Schwinger equation. (auth)

15693 SUPER-SOFT-CORE NUCLEON-NUCLEON INTERACTION WITH π-, ρ- AND ω- EXCHANGE CONTRIBUTIONS. Tourreil, R. de (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Rouben, B. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire); Sprung, D. W. L. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 242: No. 3, 445-460(5 May 1975).

An improved version of the super-soft-core interaction is presented. The known π-, ρ- and ω-exchange contribution are incorporated, while the core and the remainder of the intermediate range are treated phenomenologically. The potential gives a high-quality fit to the two-body bound-state and scattering data up to 350 MeV. The amplitudes are weak in the sense that in nuclear matter, the ratio of second-order to first-order energy perturbations (for the scalar components) are in the region 20-30%. The wound integral $\kappa = 0.077$ at $\kappa_T = 1.4$ fm^{-1}. The triplet-even tensor component is weaker than in other phenomenological potentials, but the deuteron form factor is well reproduced. The percentage D-state is 5.92%. (auth)

15694 NON-EIKONAL PROPAGATION EFFECTS IN THE MULTIPLE SCATTERING OF HADRONS FROM NUCLEI AT MEDIUM ENERGIES. Bleszynski, M.; Jaroszewicz, T. (Institute of Nuclear Physics, Krakow (Poland)). Phys. Lett., B; 56: No. 5, 427-430(26 May 1975).

A multiple scattering formula is discussed which takes into account exactly free propagation of the projectile in the nucleus. For high energies it coincides with the Glauber model, and it gives important corrections (in particular in the diffractive minima) at medium energies. The formula is then applied to the proton-He4 elastic scattering at 1 GeV kinetic energy. (auth)

15695 SLOPE OF ψ REGGE TRAJECTORIES AND A TEST OF "ELEMENTARITY" OF THE ψ PARTICLES IN 2ψ PRODUCTION BY HADRONS. Suzuki, M. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. Lett. 34: No. 22, 1412-1415 (2 June 1975).

If the ψ particles are not Reggeons, the cross section for 2ψ production would rise to $\sim 10^{-32}$ cm^2 in high-energy hadron-hadron collisions. This is based on the observed photoproduction of a single ψ. (auth)

15696 UNITARITY BOUNDS FOR INELASTIC DIFFRACTION. Caneschi, L.; Grassberger, P.; Miettinen, H. I. (European Organization for Nuclear Research, Geneva (Switzerland)); Henyey, F. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Phys. Lett., B; 56: No. 4, 359-363(12 May 1975).

Unitarity in the s-channel is invoked to derive an upper bound for the inelastic diffractive cross-section as a function of impact parameter. The application of this bound to high-energy proton-proton scattering strongly suggests that inelastic diffraction should be peripheral in the impact parameter space. (auth)

15697 INTERMEDIATE RANGE BARYON-BARYON POTENTIALS. de la Torre, A.; Dosch, H. G. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 56: No. 4, 343-346(12 May 1975).

Information about the sign and strength of the two pion exchange contribution to the baryon-baryon potentials is obtained by relating them to the corresponding NN and NA potentials. (auth)

15698 DETERMINATION OF DIFFRACTIVE CROSS SECTIONS FROM THE INCLUSIVE π^-/π^+ RATIO. Low, H.B.; Phua, K. (Instituto for Natural Sciences and Department of Physics, Nanyang University, Singapore 22, Republic of Singapore). Phys. Rev. D 11: No. 9, 2456-2460 (1 May 1975).

By using general kinematic features of fragmentation processes, a method is proposed to evaluate the ratio of diffractive cross sections from the inclusive π^-/π^+ particle ratio. (auth)

15699 NONLINEAR MODEL FOR ELASTIC NUCLEON-NUCLEON SCATTERING OUTSIDE THE CORE. Bock, C.W. (Department of Physics, Philadelphia College of Textiles and Science, Philadelphia, Pennsylvania 19144); Haracz, R.D. Phys. Rev. D 11: No. 9, 2662-2666 (1 May 1975).

A nonlinear pion-nucleon interaction, first applied to nucleon-nucleon scattering by Gupta and his collaborators, is reexamined in the context of a pion and meson-resonance model. It is shown that a pion-nucleon interaction, bilinear in the pion field operators, is a sensible correction to the usual one-pion-exchange, two-pion-exchange, and vector-resonance contributions in the intermediate range of the nucleon interaction ($L \geq 2$) provided the scalar resonance ϵ is strongly coupled to the nucleon. (auth)

15700 MULTIPLICITY DISTRIBUTIONS IN THE EIKONAL MODEL. Snider, D.R.; Wyld, H.W. Jr. (Physics Department, University of Illinois, Urbana, Illinois 61801). Phys. Rev. D 11: No. 9, 2538-2546 (1 May 1975).

A simple eikonal model, approximately consistent with geometric scaling, is developed and extended to predict the multiplicity distributions for high-energy inelastic reactions. It is found that the most naive form of the model does not fit the *pp* data, but that a simple modification, involving a subdivision of the available energy among the cut Pomerons in the multi-Pomeron exchange terms, does provide a reasonable fit to the data on multiplicity at 50, 69, 102, 205, 303, and 405 GeV/*c*. (auth)

15701 $\Lambda\Sigma$ CONVERSION IN HYPERNUCLEI. Dabrowski, J. (Inst. for Nuclear Research, Warsaw). Nukleonika; 20: No. 2, 199-204(1975).

The difficulties of describing the energies of S-shell hypernuclei and the Ap scattering with a ΛN interaction potential are outlined. It is shown that the difficulties may be overcome by considering $\Lambda\Sigma$ conversion. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 16115, 16118, and 16133.

15702 (CNRS-CPT-74-P-665) SPONTANEOUSLY BROKEN GAUGE SYMMETRIES AND SUPERSELECTION RULES. Roberts, J. E. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Nov 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Spontaneously broken gauge symmetries do not give rise to superselection rules so the superselection structure of the theory is determined by the subgroup of unbroken gauge symmetries. In the presence of broken gauge symmetries the observable algebra does not satisfy duality in the vacuum sector. (auth)

15703 SOME SPECULATIONS, ENDING IN A GAUGE LAGRANGIAN, ABOUT e^+e^- HADRONS, QUARK CONFINEMENT, THE NATURAL CURRENT, AND THE NATURE OF THE PHOTON. Schlereth, H. (Technische Hochschule Aachen). Lett. Nuovo Cim.; 12: No. 14, 531-536(5 Apr 1975).

The possibility of constructing the photon from other fields present in the respective Lagrangian is considered. The origin of the vacuum instability and its relation to quark confinement are discussed, and remarks are made on the construction of the neutral current. Use of BCS pair operators to construct operators of an isospin-hypercharge symmetry structure is described. (SDF)

15704 BREAKING NAMBU–GOLDSTONE CHIRAL SYMMETRIES. Pagels, H. (Rockefeller Univ., New York). pp 264-282 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

Some of the implications of the breaking of Nambu–Goldstone chiral symmetries are described including SU(3) x SU(3) as a symmetry of the strong interactions, perturbation theory about a Nambu–Goldstone symmetry, the breaking of chiral and SU(3) symmetries, and hadronic corrections to the Goldstone–Trieman relation. (JFP)

15705 GENERALIZATION OF OKUBO'S FORMULA TO FOUR-DIMENSIONAL UNITARY GROUPS. Bose, S.K. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. D 11: No. 8, 2272-2277 (15 Apr 1975).

Okubo's formula for the matrix elements of a mixed tensor is generalized from the group U(3) to the group U(4). Application of this new formula to study the structure of the mass-splitting operator in U(4) is given. (auth)

15706 RECOVERY FROM SPONTANEOUS BREAKDOWN OF CHIRAL AND GAUGE SYMMETRY IN DENSE DOMAINS OF HADRONIC MATTER. Bolzan, J.F.; Palmer, W.F. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 11: No. 10, 2932-2936 (15 May 1975).

It is speculated that chiral symmetry and the unified gauge symmetry of weak and electromagnetic interactions become exact and manifest in regions of high nuclear density. (auth)

15707 CAUSALITY, SPIN, AND EQUAL-TIME COMMUTATORS. Abdel-Rahman, A.M. (Department of Physics, University of Khartoum, Khartoum, Sudan). Phys. Rev. D 11: No. 10, 3008-3017 (15 May 1975).

We study the causality constraints on the structure of the Lorentz-antisymmetric component of the commutator of two conserved isovector currents between fermion states of equal momenta. We discuss the sum rules that follow from causality and scaling, using the recently introduced refined infinite-momentum technique. The complete set of sum rules is found to include the spin-dependent fixed-mass sum rules obtained from light-cone commutators. The causality and scaling restrictions on the structure of the electromagnetic equal-time commutators are discussed, and it is found, in particular, that causality requires the spin-dependent part of the matrix element for the time-space electromagnetic equal-time commutator to vanish identically. It is also shown, in comparison with the electromagnetic case, that the corresponding matrix element for the time-space isovector current equal-time commutator is required, by causality, to have isospin-antisymmetric tensor and scalar operator Schwinger terms. (auth)

15708 INCORPORATION OF *CP* VIOLATON WITH A UNIFIED RENORMALIZABLE GAUGE THEORY. Tomozawa, Y. (Randall Laboratory of Physics, The University of Michigan, Ann Arbor, Michigan 48104); Yun, S.K. Phys. Rev. D 11: No. 10, 3018-3025 (15 May 1975).

A unified renormalizable gauge theory with *CP* violation is presented without having to introduce heavy leptons. The theory utilizes three triplets of quarks and three charmed quarks. Models in the SU(2) $\times$ U(1) and SU(2) $\times$ SU(2) $\times$ U(1) gauge groups are constructed. The *CP*-violating phases are in the hadronic sector which is partly composed of a mixture of two triplets. The lepton-hadron anomaly cancellation mechanism is adopted, and a superweak type of *CP* violation results from the model. (auth)

15709 REMARKS ON THE SUPERSYMMETRY ALGEBRA. Chakrabarti, A. (Centre de Physique Théorique de l'Ecole Polytechnique, 17, rue Descartes, 75. Paris V, France). Phys. Rev. D 11: No. 10, 3054-3058 (15 May 1975).

We study certain classes of explicit realizations of the supersymmetry algebra, including internal symmetry, and some of their properties. (auth)

15710 SU(4) SYMMETRY AND THE NEW RESONANCES. Mathur, V.; Okubo, S.; Borchardt, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 11: No. 9, 2572-2582 (1 May 1975).

Using as a basis the idea that the new resonances discovered recently at the Stanford Linear Accelerator Center and at Brookhaven National Laboratory can be fitted into an SU(4) -symmetric scheme, we examine in detail the production and decay mechanisms of these resonances. A generalization of the Weinberg spectral-function sum rule is proposed which leads to quantitative predictions for the production cross sections of these resonances in $e\bar{e}$ annihilation. Several decay mechanisms are discussed, and arguments are presented, albeit somewhat qualitatively, to suggest that the dominant decay modes are $\psi \to \eta\gamma$ and $\psi' \to \psi + 2\pi$. As an aid to the experimentalist searching for charmed particles, we have also tabulated the predicted masses of various mesons and baryons, using both the linear and the quadratic mass formulas. (auth)

15711 NEW e^+e^- RESONANCES AND CLASSIFICATION OF HADRONS BY COLOR. Ansel'm, A.A.; D'yakonov, D.I. (Leningrad Institute of Nuclear Physics). JETP Lett. 21: No. 4, 107-109 (20 Feb 1975).

We discuss the possibility of identifying new e^+e^- resonances with colored hadron states in the case of strongly broken color SU^3 symmetry, and the ensuing classification of the hadrons. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 15624, 15641, 15648, and 15801.

15712 TREE APPROXIMATION TREATMENT OF THE CHIRAL SYMMETRY BREAKING MECHANISM IN THE GENERALIZED SIGMA-MODEL AND THE SLOPE OF THE K_{l3} DECAY FORM FACTOR. Khelashvili, A. A. (Tbilisskij Gosudarstvennyj Univ. (USSR)). Nucl. Phys., B; 90: No. 2, 336-348(12 May 1975).

Using the method of Schechter and Ueda a generalized σ-model for 0^+ mesons with arbitrary bilinear symmetry breaking is investigated. Mass relations and current divergence equations are derived on the basis of the symmetry properties of the vacuum and the invariant part of the potential. Considering breaking not higher than bilinear over the fields a sum rule is derived for the slope λ_0 of the scalar form factor of K_{l3} decay from which both positive and negative values of λ_0 follow. Moreover, the negative values of λ_0 in the model do not contradict the observed meson mass spectrum. It is also shown that when $\lambda_0 < 0$ the chiral symmetry SU(2) $\otimes$ SU(2) is not more preferable than the symmetry SU(3), if only the pure (3.3) $\oplus$ (3,3) representation is taken into account in the hadron Hamiltonian. The addition of the (1.8) $\oplus$ (8.1), term together with (3,$\bar{3}$) $\oplus$ ($\bar{3}$.3) makes the symmetry SU(2) $\otimes$ SU(2) predominant. The mechanism of chiral symmetry breaking naturally leads to the enhancement of the ratio $\langle\mu_8\rangle_0/\langle\mu_0\rangle_0$ without any appreciable breaking of vacuum symmetry in multiplets. (auth)

15713 THE SU(3) PROPERTIES OF THE PHOTON AND THE NEW RESONANCES. Gupta, V.; Koegerler, R. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 56: No. 5, 473-476(26 May 1975).

Some model-independent tests are proposed for the presence of an SU(3) singlet piece in the electromagnetic current. Tests are also proposed to determine whether or not the new resonances ψ(3105) and ψ'(3695) are admixtures of an SU(3) singlet and the eight component of an octet. It is pointed out that the study of e^+e^- annihilation into certain exclusive channels can help to resolve the SU(3) structure of the photon, ψ, and ψ'. (auth)

15714 "NATURAL" LEFT-RIGHT SYMMETRY. Mohapatra, R. N. (Department of Physics, The City College of The City University of New York, New York, New York 10031); Pati, J. C. Phys. Rev., D.; 11: No. 9, 2558-2561 (1 May 1975).

It is remarked that left-right symmetry of the starting gauge interactions is retained as a "natural" symmetry if it is broken in no way except possibly by mass terms in the Lagrangian. The implications of this result for the unification of coupling constants and for parity nonconservation at low and high energies are stressed. (auth)

15715 APPROXIMATE SCALE INVARIANCE AND $\lim_{s\to\infty}$ [$\sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$] IN THE SU(3) LIMIT. Eliezer, S. (Physics Department, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. D 11: No. 9, 2670-2671 (1 May 1975).

Using an anomalous Ward identity for (trace of the stress-energy-momentum tensor) $\times$ (electromagnetic current)^2 with PCDC (partially conserved dilation current) via two isoscalars ϵ (700) and S^* (980) we get $\lim_{s\to\infty}[\sigma(e^+e^- \to \text{hadrons}) / \sigma(e^+e^- \to \mu^+\mu^-)] \simeq 24 m_P{}^2/m_\epsilon{}^2 \simeq 8$ [$m_P{}^2$ being the average mass^2 of the pseudoscalar SU(3) octet]. (auth)

Applications (Strong)

Refer also to abstracts 15673, 15683, and 15999.

15716 (DESY-75/10) MASS FORMULAS FOR BROKEN SU(4). Kazi, A.; Kramer, G.; Schiller, D. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). May 1975. 32p. Dep. NTIS (US Sales Only) $4.75.

Mass formulas are derived for broken SU(4) using Okubo's tensor formalism. The mass splitting term is a superposition of an SU(3) scalar operator and the I = 0 component of the SU(3) octet. To accomodate the new resonances, mixing between the SU(4) singlet and fifteenplet is discussed. In addition one considers also the electromagnetic mass shift. (auth)

15717 (DESY-75/11) DECAY PROPERTIES OF THE NEW VECTOR MESONS IN BROKEN SU(4). Kazi, A.; Kramer, G.; Schiller, D. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). May 1975. 45p. Dep. NTIS (US Sales Only) $5.25.

Mass spectra are calculated for vector, pseudoscalar and tensor mesons on the basis of singlet and fifteenplet mixing in broken SU(4), and study the dependence of wave functions on input masses. With these wave functions various two-body decays of ψ(3.1) with SU(4) invariant couplings are computed. (auth)

15718 DEPARTURES FROM CHIRAL SYMMETRY. Pagels, H. (Rockefeller Univ., New York (USA)). Phys. Rep.; 16: No. 5, 219-311(Mar 1975).

204 refs.

The physical concepts supporting the notion of an approximate hadron symmetry with special emphasis on the Nambu-Goldstone realization of chiral SU(2) $\times$ SU(2) and SU(3) $\times$ SU(3) are reviewed. The role of perturbation theory in the symmetry breaking as the technical instrument to connect broken symmetries with experiment is stressed. This is an alternate to the treatments that stress PCAC and current algebra. It is found that chiral SU(2) $\times$ SU(2) is a good hadron symmetry to within 7% making it the best hadron symmetry after isotopic symmetry. The nonrenormalization theorem, Σ-terms, K_{l3} decay, $\eta \to 3\pi$ decay, the Goldberger-Treiman relation and many other specific processes and their relation to approximate chiral symmetry are discussed. (auth)

Scattering Theory

Refer also to abstracts 15655, 15660, 15693, 15696, 15975, 16060, 16097, and 16099.

15719 (CNRS-CPT-74-P-635) TIME DEPENDENT SCATTERING THEORY. Robinson, D. W. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Jul 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

The general formalism of time-dependent quantum mechanical scattering theory is reviewed, and a number of relatively recent results are described. The discussion includes dynamics and self-adjointness, bound and dispersive states, scattering systems, the existence of wave matrices, asymptotic completeness, and local smoothness. (JFP)

15720 (CNRS-CPT-74-P-664) MULTICOMPONENT FINITE ENERGY SUM RULES FROM DIRICHLET SERIES. Mandelbrojt, J. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Nov 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

Denoting by family of Regge trajectories, a mother trajectory and its daughters, and any trajectory which is exchange degenerate with one of them, it is shown that the finite energy sum rules for an amplitude can be split up into as many finite energy sum rules as there are families of trajectories. One thus gets multicomponent FESR. It is also shown that a resonance of A corresponds to a single family of Regge poles, so that a correspondance can be established between resonances and families of trajectories. The resonance approximation in the multicomponent FESR then leads to a new duality. (auth)

15721 (RL-75-064) ANALYTIC PROPERTIES OF THE REGGEON–REGGEON AMPLITUDE. Kwiecinski, J. (Science Research Council, Chilton (UK). Rutherford Lab.). Apr 1975. 36p. Dep. NTIS (US Sales Only) $5.00.

The analytic properties of the Reggeon–Reggeon amplitude in the missing-mass like variable are discussed. (This amplitude is defined through the suitable high energy limit of the eight point amplitude.) It is shown on the basis of simple Feynmann diagrams that it is possible to define reduced amplitudes which are free from kinematical singularities provided that the eight point amplitude is expressed in a form explicitly consistent with Steinmann relations. In a simple model which is considered, the reduced amplitudes have the singularity structure of ordinary two-body scattering amplitudes. The finite energy sum rules and four Reggeon vertices are also briefly discussed. (auth)

15722 L^2 DISCRETIZATIONS OF THE CONTINUUM: RADIAL KINETIC ENERGY AND COULOMB HAMILTONIAN. Yamani, H. A. (Harvard Univ., Cambridge, MA); Reinhardt, W. P. Phys. Rev., A.; 11: No. 4, 1144-1156(Apr 1975).

The relation between the matrix eigenvalues of the L^2 discretization of an operator with a continuous spectrum and Gaussian quadrature is discussed for the radial kinetic energy and for the attractive and repulsive Coulomb Hamiltonians. It is shown that discretization of the radial kinetic energy in a Laguerre- (Slater-) type basis gives a Gegenbauer quadrature, while discretization in an oscillator- (Gaussian-) type basis generates a Laguerre quadrature. Laguerre discretization of the Coulomb problem gives a Pollaczek quadrature in the repulsive case, and a new modified Pollaczek quadrature in the attractive case. The utility of these results is shown in applications to potential scattering and photoionization. Two numerical techniques for obtaining "equivalent quadrature" weights are discussed: a matrix method due to Gordon, and a very simple interpolatory method due to Heller. (auth)

15723 LOCAL FORM FOR THE SPECTRAL FUNCTION OF THE MATRIX ELEMENT $\langle 0|[V_\mu^\alpha(x), V_\nu^\beta(0)]S_\nu^*(p)\rangle$. Fakirov, D. G. Bulg. J. Phys.; 1: No. 1, 31-41(1974). (In Russian).

A local expression for the spectral function of the matrix element of the current commutator $[V_\mu^\alpha(x), V_\nu^\beta(0)]$ between vacuum and one-particle boson state is found in explicit form. The local approximation results in the discussed approach as a consequence of definite conditions imposed on the set of the intermediate states, taking part in the saturation of the considered commutator. This set comprises all possible one-particle states and two-particle states with one disconnected particle. As a consequence of the natural requirement for local commutativity of the starting current commutator, based on the supposition that the components $V_\mu^\alpha(x)$ of the octets of the current densities—vector and axial vector—are operators corresponding to physical quantities, one obtains strictly definite conditions for locality, connecting decay and bound constants related with some real processes in which bosons take part. (auth)

15724 METHOD OF THE EXTENDED S-MATRIX AND De SITTER MOMENTUM SPACE. Donkov, A. D.; Kadyshevskii, V. G.; Mateev, M. D.; Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Bulg. J. Phys.; 1: No. 1, 58-69(1974). (In Russian).

The hypothesis is forwarded that the extension of the scattering matrix off the mass shell has to be done in 4-dimensional De Sitter momentum space and not in flat Minkowski p-space, as it is currently accepted in local quantum field theory. Corresponding free field theory is developed, and new extended S-matrix coefficient functions and currents are constructed. (auth)

15725 TWO-COMPONENT PHOTON AND THE ANOMALY STRUCTURE OF PHOTON–PHOTON SCATTERING. Schlereth, H. (Technische Hochschule Aachen). Lett. Nuovo Cim.; 12: No. 14, 522-526(5 Apr 1975).

A two-component model is discussed in which the photon is replaced by an elementary field in the bounded region to which quarks are confined, and in the region in which ordinary hadrons are found, appears as a collective excitation of the fields comprising the electromagnetic current. Photon–photon scattering is considered in the duality context. (SDF)

15726 SCATTERING AT LOW ENERGIES AND THE INVERSE PROBLEM AT FIXED ANGULAR MOMENTUM. Lambert, F. (Brussels Univ. (Belgium)); Corbella, O. (Rosario Univ. Nacional (Argentina). Departamento de Fisica); Thome, Z. D. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 90: No. 2, 267-284(12 May 1975).

The inverse formalism at fixed angular momentum is considered and the problem of how to associate a meaningful regular potential with a given number of scattering parameters in the effective range expansion of an S-wave phase shift is examined. Under the assumption that there are no bound states, $\kappa \cot \delta(\kappa)$ is expanded as a continued fraction in κ^2 and it is shown that the necessary condition $\delta(\infty)-\delta(0) = 0$ is sufficient in order that a given [N/M] Padé approximant of $\kappa \cot \delta(\kappa)$, with $M \leq N - 1$, be exactly reproducible by a regular Bargmann potential $V_N^B(r)$. Explicit conditions on the coefficients of the 3 lower [N/M] Padé approximants (and thus on the first four scattering parameters) are derived for the existence of unique $V_{1,2}^B$ potentials which reproduce exactly such extrapolations. These potentials are found to be stable against the noise produced by experimental errors on the scattering parameters. (auth)

15727 THE PROPERTIES OF THE JOST FUNCTION FOR CUT POTENTIALS, AND THE RECIPROCAL PROBLEM. Chadan, K. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique Theorique et Particules Elementaires). Ann. Inst. Henri Poincare, Sect. A; 21: No. 3, 233-244(1974). (In French).

A theorem giving the Jost function of a local potential having other complementary properties is demonstrated. (FR)

15728 SCATTERING THEORY WITH SINGULAR POTENTIALS. I. The Two-Body Problem. Robinson, D. W. (Aix-Marseille-2 Univ., 13 - Marseille (France). Centre Universitaire de Luminy). Ann. Inst. Henri Poincare, Sect. A; 21: No. 3, 185-215(1974).

The definition of a self-adjoint Hamiltonian for a two-body system interacting with a positive singular potential is considered. For highly singular potentials a result of essential self-adjointness is obtained, for less singular potentials the equality of the Friederichs extension and the form sum extension is proved. An approximation scheme is introduced for singular potentials, and it is demonstrated that if the potentials are approximated from below by bounded potentials then the corresponding Hamiltonians converge in the strong resolvent sense. Lavine's results on scattering with positive, decreasing, H_0-relatively bounded potentials are extended to positive, decreasing potentials with an arbitrary singularity at the origin. In particular the absolute continuity of the spectrum and strong asymptotic completeness are established. Monotonicity criteria are developed for the application of perturbation theory to systems with a residual repulsive interaction. Results on the negative spectrum by linear bounds, and weak asymptotic completeness, by quadratic bounds are obtained. These results are illustrated by a discussion of the Lennard-Jones interaction. Most of these results are valid in all but two dimensions. (FR)

15729 SCATTERING THEORY WITH SINGULAR POTENTIALS. II. The N-Body Problem and Hard Cores. Ferrero, P.; Pazzis, Olivier de (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique); Robinson, D. W. (Aix-Marseille-2 Univ., 13 - Marseille (France). Centre Universitaire de Luminy). Ann. Inst. Henri Poincare, Sect. A; 21: No. 3, 217-231(1974).

Results of absolute continuity and asymptotic completeness are proved for n-particles interacting with positive, spherically symmetric, decreasing potentials which are arbitararily singular

at the origin. Hard cores are also allowed. In particular the scattering matrix for n hard spheres is shown to be unitary. Results for weakly attractive potentials are also given. These results are valid in all but two dimensional space. (FR)

15730 A MODEL FOR REGGE CUTS WITH POLE ENHANCEMENT. Collins, P. D. B.; Fitton, A. (Durham Univ. (UK)). Nucl. Phys., B; 91: No. 2, 332-358(2 Jun 1975).

It is argued that, since hadronic processes show Regge shrinkage even at large $|t|$, Regge-cut discontinuities must be enhanced in the region of J near the Regge poles (as suggested by some recent theoretical work on the weak-coupling solution to the "infrared problem" in the Reggeon calculus) so that the dominant Regge-cut contributions (at current energies) do not come from the region of the discontinuity near the branch point (as it does in eikonal and absorption models). In particular it is shown that this hypothesis works well for $\pi^-p \to \pi^0n$. However, there is less shrinkage in photoproduction processes at large $|t|$, and it is found that in $\gamma p \to \pi^0 p$ (and related processes) there is no pole enhancement of the cuts. This fact is connected with the absence of t-channel unitarity constraints for electromagnetic processes and more speculatively with the possibility that a scaling behavior due to Regge cuts develops at large $|t|$ as the mass of the external particle is decreased. (auth)

15731 COMMENTS ON SOME PROBLEMS IN MANY-BODY SCATTERING THEORY. Benoist-Gueutal, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Phys. Lett., B; 56: No. 5, 413-416(26 May 1975).

The relation between the transition operators T_{ij} and the solutions τ_{ij} of the coupled integral equations derived by Kouri and Levin is used to prove that their modified equations are irrelevant. It is shown that the minimal set of coupled equations must include all the two-cluster channels in order to satisfy the unitarity condition. (auth)

15732 OPTICAL THEOREMS AND STEINMANN RELATIONS. Cahill, K.E. (Centre de Physique Théorique, École Polytechnique, Paris Vᵉ, France); Stapp, H.P. Ann. Phys. (N.Y.) 90: No. 2, 438-514 (Apr 1975).

Formulas that express in terms of physical scattering functions the discontinuity of any 3-to-3 scattering function across any basic normal threshold cut are derived from field theory. These basic cuts are the cuts in channel energies that start at lowest normal thresholds and extend to plus infinity. The discontinuity across such a cut generally depends on whether it is evaluated above or below each of the remaining basic cuts. Formulas are obtained for all cases. Generalized Steinmann relations are found to hold: the 2282 boundary values from which the discontinuities across basic cuts are formed have a unique extension to a set of $2^{16} = 65{,}536$ functions, one for each combination of sides of the 16 basic cuts, such that for any pair of overlapping channels the corresponding double discontinuity vanishes. The ordinary Steinmann relations require this property to hold only for the double discontinuities formed from the original 2282 boundary values. The results are derived from the field-theoretic formalism of Bros, Epstein, and Glaser, which is slightly developed and cast into a form suited for calculations of the kind needed here. (auth)

15733 ON THE DEFINITION OF THE RESONANCE WITH EXAMPLES FROM TWO-CHANNEL MODELS. Gauthier, L. (Department of Physics, Princeton University, Jadwin Hall, Princeton, New Jersey 08540); Kamal, A. N. Ann Phys. (N. Y.) 90: No. 2, 515-529(Apr 1975).

In an exactly solvable model of separable potentials a two-channel scattering problem is solved in $l=0$ state. The location and the width of a resonance are then defined in three different ways, and the resonance parameters so extracted are then compared. This problem is of interest vis-a-vis the Δ (3,3) resonance parameters. (auth)

15734 DIAGRAM-SUMMATION METHOD IN THE THEORY OF SCATTERING OF THREE AND FOUR NONRELATIVISTIC PARTICLES. Komarov, V.V.; Popova, A.M. (Nuclear Physics Institute, Moscow State University). Sov. J. Part. Nucl. 5: No. 4, 434-450 (Apr 1975).

Integral equations are derived by a diagram-summation method for the scattering amplitudes of three and four nonrelativistic particles. The method is based on the rearrangement properties of the expansion of the scattering operator in a series given in the interaction representation. By defining the interaction operator in second-quantization space it is possible to represent the series of the scattering-operator matrix elements in the form of nonrelativistic diagrams. (auth)

15735 EFFECT OF SCREENING AS AN EIKONAL CORRECTION. Bartnik, E. A.; Iwinski, Z. R.; Namyslowski, J. M. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). Phys. Lett., A; 53: No. 1, 5-7(19 May 1975).

Imposing the known exact solution for the unscreened Coulomb field an eikonal formalism is developed for a correction due to screening. This correction turns out to be a multiplicative phase factor, easy to calculate even in the case when the potential is only given numerically. The partial wave expansion is avoided. (auth)

15736 THE THREE-BOSON STIMULATED SCATTERING BEHAVIOUR. Skorobogatov, G. A. (Leningradskij Gosudarstvennyj Univ. (USSR)). Phys. Lett., A; 53: No. 1, 2-74(19 May 1975).

The resonance behaviour of three-boson "stimulated scattering" (TBSS) which was observed recently is shown. In a sufficiently cold boson gas the zero momentum particles accumulation should take place as a result of TBSS alone without any collective effects and for any non-bonding two-particle interaction potential. (auth)

15737 PROPOSAL OF A NEW MEASURE OF CLUSTERING FOR HIGH-MULTIPLICITY EVENTS AT ASYMPTOTIC ENERGIES. Pirilä, P.; Thomas, G.H. (High Energy Physics Division. Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 11: No. 9, 2532-2537 (1 May 1975).

A one-dimensional distribution is proposed which measures the way in which particles are organized in phase space. Specifically, for N-body final states, this distribution, called the U distribution, gives a measure the frequency with which a differential cross section takes on a specified value. The analytic properties of the U distribution are studied for short-range order models. Certain generally valid results are obtained. A numerical example is given to demonstrate what might be expected. (auth)

15738 UNITARITY IN THE COMPLEX ANGULAR MOMENTUM PLANE AND THE TWO-REGGEON CUT. Moen, I.O. (Physics Department, McGill University, Montreal, Canada); Zakrzewski, W.J. Phys. Rev. D 11: No. 9, 2562-2571 (1 May 1975).

The results obtained for a two-Reggeon contribution to a scattering amplitude without continuing in the angular momentum are interpreted from the complex angular momentum plane point of view. It is shown that contributions to continued partial-wave amplitudes from two-Reggeon intermediate states can be derived, and agree with previous calculations; however, this leads to a contribution to the full amplitude which has not previously been taken into account. When this new contribution and the correct threshold in the s-channel are included, agreement with the result obtained without continuing in the angular momentum is found. (auth)

15739 A PRACTICAL RELATIVISTIC THEORY OF THREE-BODY SCATTERING. Brayshaw, D.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 9, 2583-2601 (1 May 1975).

A natural and unambiguous generalization of the boundary condition formalism previously proposed by this author is shown to result in a practical set of equations for describing relativistic three-particle scattering. These equations are exactly unitary, and can be readily generalized to the n-body case. Applied to the 0^- and 1^- states of the 3π system ($I = 0, 1, 2$), they yield the π and ω as natural consequences of the π-π s- and p-wave phases; there are no spurious predictions. The equations appear ideal for relativistic data analysis. (auth)

15740 ASYMPTOTIC COMPLETENESS IN TWO- AND THREE-PARTICLE QUANTUM MECHANICAL SCATTERING. Thomas, L.E. (Département de Physique Théorique, Section de Physique, Université de Genève, Geneva, Switzerland). Ann. Phys. (N.Y.) 90: No. 1, 127-165 (Mar 1975).

Asymptotic completeness is proved in three-particle nonrelativistic quantum mechanical potential scattering for a large class of two-body potentials $V_{ij}(x_{ij})$. The class of potentials is characterized essentially by the $V_{ij}(x_{ij})$'s vanishing faster than $|x_{ij}|^{-2-\epsilon}$, $|x_{ij}| \to \infty$ and being less singular than $|x_{ij}|^{-2+\epsilon}$ locally, for some $\epsilon > 0$. Inelastic processes are permissible. (auth)

15741 s-channel DISCONTINUITIES AND THE two-Reggeon CUT. DeGrand, T.A. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 and Department of Theoretical Physics, University of Geneva, Geneva, Switzerland). Phys. Rev. D 11: No. 8, 2233-2251 (15 Apr 1975).

We make a detailed calculation of the s-channel discontinuities of the two-Reggeon cut in order to see how the singularities of the Reggeon-particle vertices affect the weight with which an intermediate state contributes to the cutlike part of the amplitude. We confirm the counting of Halliday and Sachrajda for the Mandelstam graph and show the extent to which this result can be applied to more general cut diagrams so that the results of Abramovskii, Gribov, and Kancheli hold. We also consider amplitudes with vertices constructed from the precepts of multi-Regge theory (for instance, from a dual model) in which the counting of terms is different: In particular, the simultaneous discontinuity through both Reggeons does not contribute to the cut. The weight of a given n-particle intermediate state in forming the cut depends crucially on the analytic properties of the vertex one chooses. (auth)

15742 CROSSING MULTIPARTICLE AMPLITUDES: POLE SINGULARITIES. Klink, W.H. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). Phys. Rev. D 11: No. 8, 2278-2285 (15 Apr 1975).

Canonical variables suitable for crossing multiparticle amplitudes are discussed and then used to show that crossing a multiparticle amplitude involves analytic continuation in only one variable. A representation for analytically continuing multiparticle amplitudes in this variable is then developed for simple types of singularities. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

15743 FREQUENCY SHIFTS IN PULSED NMR FOR ^{3}He(A). Brinkman, W. F.; Smith, H. (Bell Labs., Murray Hill, N. J. (USA)). Phys. Lett., A; 51: No. 8, 449-450(5 May 1975).

The ringing frequency recently observed by Osheroff and Corruccini in pulsed NMR experiments on the A-phase of ^{3}He is calculated from Leggett's resonance equations. For large magnetic fields the frequency is $\Omega = \gamma H + (\Omega_L^2/8\gamma H)(1 + 3\cos\theta)$, where θ is the tipping angle, and Ω_L is the longitudinal resonance frequency. (auth)

15744 PULSED NMR FREQUENCY SHIFTS IN SUPERFLUID ^{3}He. Osheroff, D. D. (Bell Labs., Murray Hill, N. J. (USA)); Corruccini, L. R. (California Univ., Davis (USA). Dept. of Physics). Phys. Lett., A; 51: No. 8, 447-448(5 May 1975).

The first measurements of the NMR frequency in ^{3}He A and B under conditions where the net magnetization, M, is tipped far from its equilibrium direction along H_0 are reported. In ^{3}He A the frequency shift $\omega-\gamma H_0$ varies from the continuous wave value at tipping angle $\Phi = 0$ to a negative shift at $= 180°$. In ^{3}He B no frequency shift is observed, however for $\Phi \gtrsim 100°$ a beat pattern is seen to develop in the free induction decay envelope. (auth)

15745 OSCILLATORY SUPERFLUID FILM THINNING IN THE PRESENCE OF A BIAS CURRENT. Hallock, R. B. (Massachusetts Univ., Amherst (USA)). Phys. Lett., A; 51: No. 8, 457-459(5 May 1975).

It is argued that the asymmetry in the saturated superfluid film thickness change with respect to flow direction observed by Williams and Packard was due to the presence of a bias film flow. Measurements which support this view are presented. (auth)

15746 DETECTION OF ^{4}He ATOMS SEPARATELY EVAPORATED BY PHONONS AND ROTONS AT A FREE SUPERFLUID SURFACE. Balibar, S. (Ecole Normale Superieure, 75 - Paris (France). Groupe de Physique des Solides). Phys. Lett., A; 51: No. 8, 455-456(5 May 1975).

In these experiments, for the first time, atoms evaporated by phonons and atoms evaporated by rotons are separated using the heat pulse technique. (auth)

15747 POSSIBLE EVIDENCE FOR THE CONDENSATION OF ^{3}He ATOMS ONTO QUANTIZED VORTEX LINES. Ostermeier, R. M.; Glaberson, W. I. (Rutgers-the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Phys. Lett., A; 51: No. 7, 403-404(21 Apr 1975).

The "extrinsic" lifetime of ions trapped on vortex lines in a ^{3}He-^{4}He solution exhibits a rapid rise at low temperatures. This rise is interpreted in terms of the condensation of ^{3}He atoms onto the cores of the vortex lines. (auth)

15748 MAGNETIC SUSCEPTIBILITY OF SATURATED MIXTURES OF ^{3}He IN SUPERFLUID ^{4}He. Ghozlan, Aline; Bloyet, Daniel; Varoquaux, Eric; Vibet, Claude (Paris-11 Univ., 91 - Orsay (France). Inst. d'Electronique Fondamentale). Compt. Rend., Ser. A, B; 280: No. 9, 259-261(3 Mar 1975). (In French).

The magnetic susceptibility of dilute ^{3}He-^{4}He mixtures was measured along the phase separation curve at low pressures. The values for the interaction potential parameters obtained from these data check well with those deduced from other thermodynamic measurements. (FR)

15749 HYDRODYNAMICAL MOTIONS OF A MONODOMAIN IN THE AMB PHASE OF SUPERFLUID HELIUM THREE. Seiden, Joseph (Paris-11 Univ., 91 - Orsay (France). Inst. d'Electronique Fondamentale). Compt. Rend., Ser. A, B; 280: No. 5, 91-94 (3 Feb 1975). (In French).

The hydrodynamical equations for low amplitude motions of a monodomain in the AMB phase of superfluid helium three are derived. They contain ten viscosity coefficient if the coupling with the spins is neglected. (FR)

15750 NMR IN *A*-^{3}He AND *B*-^{3}He: THE INTRINSIC RELAXATION MECHANISM. Leggett, A.J.; Takagi, S. (School of Mathematical and Physical Sciences, University of Sussex, Falmer, Brighton BN1 9QH, Sussex, England). Phys. Rev. Lett. 34: No. 23, 1424-1427 (9 June 1975).

A previously developed theory of NMR in superfluid ^{3}He is generalized to include relaxation effects. The physical mechanism envisaged is the relaxation of nonequilibrium Cooper-pair concentrations in the different spin bands. The results should describe both linear and nonlinear phenomena for all frequency regimes. The results for continuous-wave linewidths disagree with those of Combescot and Ebisawa as to temperature dependence. (auth)

15751 THEORY OF SOUND PROPAGATION IN *B*-^{3}He. Wölfle, P. (Max-Planck-Institut für Physik und Astrophysik, D-8000 München 40, Germany). Phys. Rev. Lett. 34: No. 22, 1377-1381 (2 June 1975).

A theory of the sound attenuation and dispersion in superfluid ^{3}He is presented, which consistently takes into account three types of absorption mechanisms: (1) quasiparticle collisions, (2) pair breaking, and (3) excitation of collective modes of the order parameter. Results for the *B* phase, assuming it to be in the quasi-isotropic (Balian-Werthamer) state, are in good agreement with experiment. (auth)

15752 LARGE ANGLE TIPPING FREQUENCY SHIFTS IN PULSED NMR FOR ^{3}He(B). Brinkman, W. F.; Smith, H. (Bell Labs., Murray Hill, N. J. (USA)). Phys. Lett., A; 53: No. 1, 43-44(19 May 1975).

The absence of frequency shifts in pulsed NMR experiments on the B-phase of ^{3}He at tipping angles ψ less than 104° is explained on the basis of Leggett's resonance equations. At tipping angles greater than 104° and large magnetic fields the frequency shift $\delta\omega = -(4/15)(\Omega_L^2/\gamma H)(1 + 4\cos\psi)$, where Ω_L is the longitudinal resonance frequency of the B-phase and H is the magnetic field, is found. The consistency with the observed nuclear free precession signal is pointed out. (auth)

15753 HYDRODYNAMIC THEORY APPLIED TO FOURTH SOUND IN A MOVING SUPERFLUID. Bergman, D.J.; Halperin, B.I.; Hohenberg, P.C. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 11, 4253-4263 (1 June 1975).

The hydrodynamic equations of superfluid ^{4}He in a superleak are used to obtain an exact and general expression for the velocity of fourth sound in the presence of a steady superfluid flow. This expression, which depends only on the flow velocity and on static properties of the helium-superleak system, may be simplified when effects due to the finite-pore dimensions are negligible. In that case the fourth-sound velocity may be rewritten in terms of the flow velocity, thermodynamic properties of bulk helium and bulk filler material, and some purely geometric parameters. The expression obtained disagrees with the results of a previous calculation. A relation between the fourth-sound velocity at zero flow and the Doppler shift at finite flow, predicted by the present theory, is in conflict with existing experimental data. Possible explanations for this discrepancy are discussed. (auth)

15754 GENERAL GAUGE INVARIANCE AND SPIN WAVES IN THE *B* PHASE OF SUPERFLUID ^{3}He. Maki, K. (Department of Physics, University of Southern California, Los Angeles, California 90007). Phys. Rev. B 11: No. 11, 4264-4271 (1 June 1975).

Assuming that the *B* phase of superfluid ^{3}He is described in terms of a spherical triplet state of Balian and Werthamer, the Goldstone bosons associated with the general gauge transformation of the *B* phase are studied theoretically. Particular attention is paid to spin waves, which are the Goldstone bosons associated with (partially broken) gauge invariance of the original Hamiltonian against the rotation of the spin space. Spin-wave dispersions in the hydrodynamic regime of the *B* phase are determined. (auth)

15755 MICROSCOPIC THEORY OF INTERACTING EXCITATIONS IN BOSE SYSTEMS. Carballo, J.A.; Ruvalds, J. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. B 11: No. 11, 4278-4291 (1 June 1975).

A study of an interacting boson system is presented, which examines the internal consistency and validity of certain microscopic theories. Our formalism is based on density variables and follows closely the work of Bogoliubov and Zubarev, although the general features of the results apply to other approaches as well. First we employ model potentials to calculate the excitation spectrum, the structure factor, the condensate fraction, and the scattering amplitude for two excitations. The results demonstrate new and stringent limitations of the model-potential approach, and suggest that this type of analysis may yield fortuitous and misleading agreement with experiment when applied to liquid helium. In particular, although the theory yields a good fit to the energy spectrum (in accord with previous work), the scattering amplitude is found to be extremely sensitive to the details of the model, so the potential approach cannot be considered as a reliable basis for calculations of the excitations in superfluid helium. As an alternative, we develop a first-principles theory of helium based only on the liquid structure factor S_k. To lowest order, the latter method gives results qualitatively similar to the strong-coupling calculations. This indicates a need to consider renormalization effects, which are briefly discussed. (auth)

15756 EXPLANATION OF AN OBSERVED DIRECTION-DEPENDENT SUPERFLUID FLOW. Campbell, L.J. (Los Alamos

Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. B 11: No. 11, 4721-4724 (1 June 1975).

Several features that signify the existence of persistent current are identified in the data on film thinning of Williams and Packard. Flow calculations that reproduce their observations imply an unsuspected leak in their apparatus comparable in area to the known flow path. This analysis does not compromise their claim to have observed kinetic film thinning but helps confirm the correctness of the standard film-flow theory. (auth)

15757 INSTABILITY OF THE ROTON MODE VERSUS PRESSURE AND TEMPERATURE IN SUPERFLUID HELIUM. Solana, J. (Departamento de Física Fundamemtal, Universidad Autónoma de Madrid, Canto Blanco, Madrid, Spain). Phys. Rev. B 11: No. 11, 4728-4729 (1 June 1975).

It is shown that the instability of the roton mode in He II versus pressure and temperature can be explained consistently if the hybridization of a single roton with a bound roton pair is taken into account. (auth)

Superconductivity

Refer also to abstracts 14236, 14753, 14756, 14764, 14790, 14840, 14851–14853, 14855, 14879, 14880, 14893, 14895, 14919, 14924–14926, and 14934.

15758 (KFKI-75-25) PROBLEM OF A PHASE TRANSITION IN A ONE DIMENSIONAL FERMI SYSTEM IN THE MANY FIELD LIMIT. Menyhard, N. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 12p. Dep. NTIS (US Sales Only) $4.00.

A one dimensional model of a metal is generalized by assigning a component index to the electron creation and annihilation operators. In the limit in which the number of components n goes to infinity it is found that a mean field type phase transition occurs at a finite temperature even for short ranged interactions. It is shown that this result is not in contradictions with general theorems concerning ODLRO. (auth)

15759 NEW RESULTS WITH SUPERCONDUCTING MAGNETS. I. Properties of Superconductors. Dezso, N. (Nuclear Research Inst., Debrecen, Hungary). Fiz. Szemle; 24: No. 5, 150-156(May 1974). (In Hungarian).

At the critical transition temperature the electrical resistivity of superconducting materials undergoes a sudden drop and the material becomes infinitely conductive. The value of this temperature, T_c is characteristic for a given material but it depends also on the crystal structure and isotopic composition. For elementary metals, T_c is highest for Nb. Slight impurities affect the value of T_c somewhat. Application of a magnetic field of a certain strength terminates the superconducting state, reestablishing finite resistivity. In view of the so-called Meissner effect, the superconductor is perfectly diamagnetic. A critical current density, j_c, which at a given geometry depends on the temperature, destroys the superconducting state. These properties must be taken into account for the practical application of superconductors. The Bardeen-Cooper-Schrieffer theory of the phenomenon is examined, indicating the conditions which prevent the appearance of superconductivity. In the review of Type II superconductors the surface energy and multicomponent alloy systems are discussed. Technical application will be examined in Part II of the article. (Review article). (TTT) (10 figures)

15760 CORRELATION BETWEEN THE SUPERCONDUCTING CRITICAL TEMPERATURE AND THE NUMBER OF STABLE ISOTOPES AMONG SUPERCONDUCTING ELEMENTS. Gualtieri, D. M. (Pittsburgh Univ.). Solid State Commun.; 16: No. 7, 917-918(1 Apr 1975).

The correlation between the superconducting critical temperature and the number of stable isotopes among superconducting elements has been examined with respect to the simple empirical observations of nuclear stability and the general predictions of the BCS theory. Whereas this correlation does express a casual relationship, this relationship is merely the requirement that the number of electrons equals the number of protons in neutral atoms. The observed covariance is the result of increased nuclear stability at even atomic number and the decrease in the electron density of states at the Fermi level caused by an even number of electrons filling a Brillouin zone. (auth)

15761 MAGNETIC TRANSITION IN MODERATELY SMALL SUPERCONDUCTORS, AND THE INFLUENCE OF ELASTIC STRAIN. Bibby, B. R.; Nabarro, F. R. N.; McLachlan, D. S.; Stephen, M. J. (Univ. of the Witwatersrand, Johannesburg). Philos. Trans. R. Soc. London, Ser. A.; 278: No. 1282, 311-341 (24 Apr 1975).

Transition surfaces of moderately small, elastically strained superconductors (tin whiskers) are plotted (a) at fixed strain, (b) as a function of strain, in the range of temperature near that point at which the transition changes from one of second order to one of first order in the Ehrenfest sense. The point at which the order of the transition changes is described as a critical point of Landau type, and the form of the variation in the specific heat and other second derivatives of the Gibbs free energy near this point are derived. Since the magnetization of the sample must be expressed as a sum of powers of the order parameter up to ψ^6, it is thought necessary to extend Ginzburg's (Soviet Phys. J.E.T.P.; 7: 78-87(1958)) analysis by including a term in ψ^6 in the free energy even in the field-free case. The corresponding coefficient is estimated from experimental data, and found to be negative. The observed thermodynamic transition curve branches at a finite angle from that describing supercooling; in general the theory predicts that these two curves should be tangential at the Landau critical point. It is also shown, both experimentally and theoretically, that the transition of a small superconductor near T_c remains of second order under homogeneous elastic stress. (auth)

15762 STUDY OF SECTIONS OF TERNARY AND QUATERNARY SYSTEMS ON THE BASIS OF SUPERCONDUCTING COMPOUNDS WITH AN A15 TYPE STRUCTURE. Savitskii, E. M.; Baron, V. V.; Efimov, Yu. V.; Bychkova, M. I.; Myzenkova, L. F.; Kozlova, N. D. pp 24-31 of Issledovanie Razrezov Troinykh i Chetvernykh Sistem na Osnove Sverkhprovodiashchikh Soedinenii so Strukturoi Tipa A15. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

15763 POSSIBLE HYPO-CRITICAL POINT IN THE PHASE DIAGRAM OF A MODERATELY SMALL SUPERCONDUCTOR IN A MAGNETIC FIELD. Nabarro, F. R. N.; Bibby, B. R. (Univ. of the Witwatersrand, Johannesburg). Philos. Trans. R. Soc. London, Ser. A.; 278: No. 1282, 343-349(24 Apr 1975).

An expression for the difference in Gibbs free energy between the superconducting and normal states of a moderately small superconductor, in terms of ψ, the wave function of the superconducting electrons, has been applied to experimental observations on the transitions of tin whiskers (Bibby, Nabarro, McLachlan & Stephen. Phil. Trans. R. Soc. Lond.; A 278: 311-341 (1975)) and fails if the coefficient of the term in ψ^4 is negative at the Landau critical point. It is suggested that a term of order ψ^6 be incorporated, with a positive coefficient. It is shown that this gives rise to a transition from the normal state to a superconducting state with a finite value of ψ at a point (H^*, T^*), denoted the hypo-critical point since it occurs at a lower field than does the Landau critical point. The phase boundary describing this transition branches at a finite angle from that describing the second order transition at lower fields, the ratio of these slopes, for a cylinder in parallel field, being less than or equal to 1.32. (auth)

15764 THERMODYNAMIC PROPERTIES OF STRONG-COUPLED SUPERCONDUCTORS. Kresin, V.Z.; Parkhomenko, V.P. (Moscow State Correspondence Pedagogical Institute). Sov. Phys.—Solid State 16: No. 11, 2180-2184 (May 1975).

The discontinuity in the specific heat β at $T=T_k$, the temperature dependence of the specific heat, and the critical field are analyzed on the basis of the theory of strong-coupling superconductors. The analysis is carried out by the methods of quantum field theory, since the ordinary combinatorial approach turns out to be inadequate in this case. The dependence of thermodynamic properties on the nature of the phonon spectrum turns out to be important for strong-coupling superconductors. The analysis leads to $\beta > \beta_{BCS}$; in addition, an explanation is found for the anomalous sign of the difference $H_k(T)/H_{k0} - (1-t^2)$, where $t=T/T_k$, for strong-coupling superconductors. A comparison is made with experiment. (auth)

15765 THE JOSEPHSON JUNCTION AS A MACROSCOPIC RADIATING ATOM. Rogovin, D. (Department of Physics and Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). Ann. Phys. (N.Y.) 90: No. 1, 18-47 (Mar 1975).

We investigate the electrodynamic properties of a Josephson junction emitting coherent radiation and establish that it can be regarded as a two-level atom within the framework of the microscopic theory of superconductivity. (auth)

15766 THERMOMAGNETIC EFFECT IN A SUPERCONDUCTING RING CONTAINING A JOSEPHSON JUNCTION. Gibson, U.J.; Pipes, P.B. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755). Phys. Rev. B 11: No. 11, 4219-4220 (1 June 1975).

A method for generating magnetic flux through a ring containing a Josephson junction by means of an applied temperature gradient is described. The size of the effect is estimated and a method of detection is suggested. (auth)

15767 SUPERCONDUCTIVITY AND THE PERIODIC SYSTEM. Veljković, V.; Lalović, D.I. (Laboratory for Theoretical Physics, Boris

Kidrič Institute, Beograd, Yugoslavia). Phys. Rev. B 11: No. 11, 4242-4245 (1 June 1975).

The variation of the transition temperature T_c with the number of the valence electrons is shown to be the result of the cooperative action of $N(0)$ and V_{ph}. (auth)

15768 CONTRIBUTION TO THE MICROSCOPIC THEORY OF THE JOSEPHSON EFFECT IN SUPERCONDUCTING BRIDGES.

Kulik, I.O.; Omel'yanchuk, A.N. (Physico-technical Institute of Low Temperatures, Ukrainian Academy of Sciences). JETP Lett. 21: No. 4, 96-97 (20 Feb 1975).

We consider the properties of superconducting bridges (*S–C–S* junctions) in the dirty limit $l \ll \xi_0$ at arbitrary temperatures. We find the dependence of the Josephson current on the phase shift. At $T=0$ we have $dI/d\phi = -\infty$ at the point $\phi = \pi$. (auth)

15769 NEW TYPES OF INSTABILITIES IN NONEQUILIBRIUM EXCITATION OF A SUPERCONDUCTOR.

Baru, V.G.; Sukhanov, A.A. (Institute of Radio Engineering and Electronics, USSR Academy of Sciences). JETP Lett. 21: No. 4, 93-94 (20 Feb 1975).

It is shown that when the nonequilibrium quasiparticles reach a critical density, a superconductor becomes unstable against a transition to an inhomogeneous state with a periodically modulated gap Δ. At the same time, an instability of a different type arises and corresponds to a transition to a homogeneous state with superconducting velocity V_s. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 16604 and 16605.

15770 (CEA-CONF-2972) DETERMINATION OF A COHERENT PARAMETER SET FOR COUPLED CHANNEL CALCULATIONS OF ^{238}U NEUTRON CROSS-SECTIONS FROM 10 keV TO 20 MeV. Lagrange, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1974. 12p. (CONF-7409106-7). Dep. NTIS (US Sales Only) $4.00.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

Since ^{238}U is a highly deformed nucleus, a deformed optical potential for neutron cross-section calculations is employed. Two sets of base states are used: $(0^+, 2^+)$ and $(0^+, 2^+, 4^+)$. In each case, the optical parameter set was chosen as to satisfy the following experimental constraints: the s- and p-wave strength functions, the potential scattering cross-section at low energy and also the total cross-section from 10 keV to 20 MeV. The results are discussed. (2 tables, 3 figures) (auth)

15771 (HEDL-SA-774) ENDF/B DOSIMETRY CROSS SECTION FILE BENCHMARK NEUTRON FLUX-SPECTRAL UNCERTAINTIES. McElroy, W. N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-2170. 13p. (CONF-750303-65). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

An ENDF/B file of evaluated energy dependent cross sections for dosimetry applications has been established. Absolute values of reaction rates and ratios are being established for a series of benchmark neutron spectra for data testing of this and other files. Here, the fission and most reliable non-fission reaction cross sections on the ENDF/B-IV file are used with current recommended sets of evaluated measured reaction rates for several benchmark spectra to establish multiple foil derived flux-spectra with Monte Carlo uncertainties. By comparison with spectrometry and calculated spectra, uncertainty estimates can be established for currently recommended benchmark flux-spectra. It is concluded that integral data testing of cross sections on the ENDF/B-IV file is presently limited to the +-5 to 10 percent (1 sigma) range because of uncertainties in the benchmark flux-spectra. (1 figure, 1 table) (auth)

15772 RAY-EFFECT MITIGATION IN DISCRETE ORDINATE-LIKE ANGULAR FINITE ELEMENT APPROXIMATIONS IN NEUTRON TRANSPORT. Briggs, L. L.; Miller, W. F. Jr.; Lewis, E. E. (Northwestern Univ., Evanston, IL). Nucl. Sci. Eng.; 57: No. 3, 205-217(Jul 1975).

A generalization is made of a previous phase-space finite element approximation of the second-order form of the one-group, two-dimensional neutron transport equation in x-y geometry. Three angular approximations are formulated and compared: continuous piecewise bilinear finite element, piecewise constant finite element, and discrete ordinate. These are incorporated into a unified formalism of discrete ordinate-like equations, enabling the spatial variables to be treated identically using piecewise or bilinear finite elements. The resulting equations are solved iteratively by a weighted conjugate gradient method in an improved version of the computer code FENT. Numerical and analytical comparisons of the angular approximations are made, and it is found that both piecewise bilinear and piecewise constant approximations in angle substantially mitigate ray effects. The mitigation is shown to be associated closely with transformation of the hyperbolic discrete ordinate equations to the elliptic operators of the discrete ordinate-like finite element approximations. This transformation is accompanied by the disappearance of the characteristics along the discrete lines of neutron travel, and, hence, by the appearance of physically artificial derivative terms normal to the lines of neutron streaming. These terms grow with the subdomains of the angular finite elements. (auth)

15773 MAGNETIC NEUTRON GUIDE TUBE FOR POLARIZATION OF THERMAL NEUTRONS WITH P = 97% IRRESPECTIVE OF WAVELENGTH. Schaerpf, O. (Technische Univ., Braunschweig, Ger.). J. Phys., E (London); 8: No. 4, 268-269(Apr 1975).

A simple low cost polarizer and analyzer for thermal neutrons is described which allows a 97% degree of polarization irrespective of the neutron wavelength. The necessary magnetization is achieved by commercially available permanent magnets directly attached at the rear of the Vacoflux 50 mirror sheets. (auth)

15774 FORMULATION OF A RITZ–GALERKIN TYPE PROCEDURE FOR THE APPROXIMATE SOLUTION OF THE NEUTRON TRANSPORT EQUATION. Kaper, H. G.; Leaf, G. K.; Lindeman, A. J. (Argonne National Lab., IL). J. Math. Anal. Appl.; 50: No. 1, 42-65(Apr 1975).

The one-group neutron transport equation is commonly given as an integro-differential equation for the neutron density psi(x,omega) over a domain G x S in the five-dimensional phase space E_3 x S(vertical bar omega vertical bar equals 1). It is shown how, by decomposing the domain of the transport operator into a complementary pair of manifolds by means of a projection operator, any transport problem can be formulated, on either manifold, in terms of a symmetric positive definite operator. Friedrichs' method is used to extend the operator to a selfadjoint operator and look for a generalized solution by minimizing a certain functional over the appropriate Hilbert space. A Ritz–Galerkin type approximation procedure is formulated, and an estimate for the difference between the exact and approximate solution is given. The procedure is illustrated for a special choice of finite dimensional subspace. (auth)

15775 PATH SPACE PICTURE FOR FEYNMAN-KAC AVERAGES. Ezawa, H.; Klauder, J. R.; Shepp, L. A. (Bell Labs., Murray Hill, NJ). Ann. Phys. (N.Y.); 88: No. 2, 588-620(Dec 1974).

In a Wiener process the paths x(t) identical with Z(t) execute the diffusive behavior of a free particle, and that is reflected by the (Wiener) measure mu/sub Z/[x(.)] on path space (concentrated on continuous paths x(t), 0 less than or equal to t less than or equal to T, say). The general Feynman-Kac average of a functional f[x(.)] on path space in the presence of a potential lambdaV(x,t) is given by the exponential representing the distortion of the distribution of the free-particle paths introduced by the potential. Alternatively, as is shown, for a given lambdaV, it is possible to construct a new Markov process with continuous sample paths x(t) identical with Y(t), the diffusive behavior of which already includes the effect of the potential in such a way that the Feynman-Kac average may be expressed in the form, F equals integral f[Rx(.)]dmu/sub Z/[x(.)]. The variable R is a map on path space under which Z(t) yields Y(t). The new process Y(t) satisfies an imaginary time Newtonian equation of motion appropriate for the potential and in the presence of additional "quantum forces" as generated by the Wiener process Z(t). In understanding these two equivalent descriptions of the average F, it may be helpful to observe that the first (Z-) description is like the interaction picture of quantum mechanics while the second (Y-) description corresponds to the Heisenberg picture. A number of interesting properties of the Y-process and their significance for quantum mechanics are exhibited. (auth)

15776 TOTAL NEUTRON CROSS SECTION OF HYDROGENATED TERPHENYLS FOR NEUTRON ENERGIES BETWEEN 0.002 AND 1.6 eV. Robitaille, H. A.; Hewitt, J. S. (Univ. of Toronto). Nucl. Sci. Eng.; 57: No. 1, 12-17(May 1975).

An experiment has been performed to measure the total neutron cross section of the terphenyl mixture, known commercially as HB-40, for neutron energies in the range 0.002 to 1.6 eV. The cross sections were measured both for a fresh sample and for a sample that had a prolonged exposure to both neutron and gamma radiation. The microscopic cross sections due to scattering from the hydrogen nuclei in the material have been determined to an accuracy of better than 5 percent and have been compared to those of benzene (C_6H_6). The terphenyl cross sections are very similar to those of benzene. (2 figures, 1 table) (auth)

15777 INFLUENCE OF DEEP MINIMA ON MULTIGROUP CROSS-SECTION GENERATION. Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 57: No. 1, 75-77 (May 1975).

It is demonstrated that conventional group constant generation methods can break down for single materials having deep cross-section minima. Implications for the analysis of fast neutron spectra in iron are discussed. A possible resolution of the difficulty based on Bn theory is advanced. (1 table) (auth)

15778 MEAN-CHORD-LENGTH APPROXIMATIONS IN THE INTERFACE-CURRENTS FORMULATION OF THE COLLISION-PROBABILITIES TECHNIQUES. Sicilian, J. M.; Anderson, M. M. Jr. (E. I. du Pont de Nemours and Co., Aiken, SC). Nucl. Sci. Eng.; 57: No. 1, 78-81(May 1975).

The use of several mean-chord-length approximations to interface-currents matrix elements are investigated. On the basis of comparison with numerical integration, an approximate technique

is proposed which greatly reduces the demands upon the storage and time capacities of the computer in performing interface-currents calculations in the multiple-mode angular current representation. (4 figures) (auth)

15779 TREATMENT OF FIRST- AND LAST-COLLISION EFFECTS IN NEUTRON AGE THEORY. Epstein, G.; Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 57: No. 1, 81-84(May 1975).

One limitation of conventional neutron age theory is that the first collision made by a particle when emitted by a source occurs right at the source. If a first-collision source is used explicitly, one no longer obtains an analytical solution, a principal advantage of age theory. An approximate form that permits analytical solution is used for the distribution of first collisions in plane geometry. Substantial improvement over age theory results. (6 figures) (auth)

15780 USE OF THE LIGHT-WATER NEUTRON SCATTERING KERNEL IN THE STUDY OF NEUTRON TRANSPORT PROCESSES IN MIXTURES OF LIGHT AND HEAVY WATER. Tewari, S. P. (Univ. of Delhi). Nucl. Sci. Eng.; 57: No. 1, 92-93(May 1975).

A method of studying neutron transport properties in H_2O-D_2O mixtures, both liquid and solid, which extrapolates the neutron thermalization parameters of H_2O is described. The decay of pulsed neutrons in the media has been investigated as an example of the application of the method. The results of the calculations agree with the experiment for concentrations up to 50 percent D_2O. (1 figure) (auth)

15781 THE INFLUENCE OF SPECULAR AND DIFFUSE REFLECTION ON THE EXTRAPOLATION DISTANCE. Williams, M. M. R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering). Atomkernenergie; 25: No. 1, 19-23(1975).

2 tabs.; 10 refs.

The effect of specular and diffuse reflection on the extrapolation distance has been assessed. The problem is formulated in terms of a general, energy dependent integral equation for a half-space of purely scattering material. We also consider an energy dependent generalisation of the cylindrical void problem formulated by Carter and Jarvis. In the case of one-speed transport theory, an exact solution has been obtained for the problem of diffuse reflection by means of the Wiener-Hopf technique. For the more general case a variational principle is employed which leads to accurate values. We have shown that, for a given reflected fraction, specular reflection leads to a greater increase in the extrapolation distance than does diffuse reflection. Energy dependent corrections do not appear to be of great importance although for very accurate interpretations of certain benchmark experiments they must be included. It is shown that for small amounts of reflection the extrapolation distance is simply related to the reflected fraction; moreover, our results are illustrated by association with the pulsed neutron experiment and the effect of room return and surface reflection on its interpretation. (auth)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 15462, 15897, and 15972.

15782 (CEA-CONF-2974) EXPERIMENTAL STUDY OF THE DEUTERON INDUCED DEUTERON BREAK-UP AT LOW ENERGY. Cocu, F.; Ambrosino, G.; Guerreau, D.; Lachkar, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1974. 9p. (CONF-7409106-2). Dep. NTIS (US Sales Only) $4.00.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

The quasi-free scattering process has been studied from the $d + D \rightarrow n + p + D$ reaction at 6 deuteron energies between 6.77 MeV to 11.7 MeV in steps of 1 MeV. Coincident events between neutron and charged-particle pulses (emitted protons or deuterons) have been recorded at angles of $\theta_p = \theta_d = 19°5$ and $\theta_n = 330°$. Some calculations using the plane wave approximation account for the shape of the experimental cross sections but not for their magnitude. Two kinds of nucleon-nucleon forces are used and discussed. (3 figures) (auth)

15783 (ITP-74-106P) COMPLETE ELECTROSPLITTING OF THREE-NUCLEON NUCLEI. Tartakovskii, V. K.; Levshin, E. B. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The processes of three-particle splitting of He^3 and H^3 under the fast electron inelastic scattering are investigated. The angular and energy distributions of scattered electrons and the produced nucleons are calculated using the model Gaussian wave functions in the initial and final states. The calculations are performed taking into account the kinematics of the process with the electron and three nucleons participating in it. The effect of contribution of the intermediate symmetry functions into the three-nucleon nuclei ground states and the interaction in the finite state on the behavior of the electrosplitting cross sections is investigated. A comparison with the available experimental data is performed as well as the study of possible reasons of divergence with these data of the earlier calculations on a complete electrosplitting of He^3. The approximations are considered when the interaction between all three nucleons simultaneously is taken into account. (7 figures) (auth)

15784 (NP-20425) PION-EXCHANGE CONTRIBUTIONS TO THE (γ,p) REACTION ON DEUTERIUM AND HELIUM NUCLEI AT MEDIUM ENERGY. Finjord, J. (Trondheim Univ. (Norway). Institutt for Fysikk). Feb 1974. 121p. Dep. NTIS (US Sales Only) $9.25.

The formalism for computation of pion-exchange contributions to the (γ,p) two-body photodisintegration of d, ^{3}He, and ^{4}He nuclei is developed. Fermi motion effects are included since the nuclear wave functions are written as Fourier integrals over momentum space. The CGLN photoproduction amplitude and a pseudoscalar ETA-NN interaction are used at the vertices; Ferrari-Selleri's form factor is used to modify the propagator and vertices for off-shell effects. A review of the currently used wave functions for the nuclei considered is presented. Final-state interactions between the proton and the final nucleus are not considered. The electromagnetic interaction is considered in an Appendix. Numerical results for Hulthén deuteron wave functions and Irving or Jain-Srivastava helium wave functions are presented; only the symmetric S nuclear states are taken into consideration, and the energy prescription is essentially on-shell; E_γ is between 165 and 330 MeV. A Frascati experiment exhibits a top in the differential cross section at 90° (CM) for ^{4}He at 260 MeV, while a Saclay experiment shows monotonously decreasing curves for both helium nuclei in the medium energy range. The calculations support the qualitative features of the latter experiment; the effect of the N* resonance is found to be less important than in the speculations of the Frascati group. The results depend strongly on the choice of wave functions, so that the quantitative importance of the approximations cannot be stated exactly. The pion exchange seems to give the dominant contribution in the medium energy range, however. (auth)

15785 THERMAL-NEUTRON TRANSPORT PROCESSES IN HEAVY WATER IN THE TEMPERATURE RANGE OF 253 TO 4 K. Gangwani, G. S. (Dyal Singh Coll., New Delhi); Tewari, S. P.; Kothari, L. S. Nucl. Sci. Eng.; 57: No. 1, 63-74(May 1975).

Calculations are reported for time-dependent, space-dependent, and steady-state neutron spectra in D_2O ice assemblies of different dimensions and in the temperature range of 253 to 4°K. The scattering kernel used for these studies incorporates one- and two-phonon processes and is based on the Debye distribution function for the lattice vibrations of the D_2O crystal. The multigroup Boltzmann diffusion equation was diagonalized to obtain transient and asymptotic spectra in assemblies at different temperatures with bucklings ranging from 0 to 0.15 cm^{-2}. The calculated values of the effective decay constant are found to agree reasonably well with the experimental values reported by Salaita and Robeson at 253°K for waiting times of 160 to 320 mu sec. The appropriate Boltzmann operator for the space-dependent problem was diagonalized to obtain its eigenvalues and eigenfunctions. By using these eigenfunctions, neutron spectra at different distances from the source plane were calculated in D_2O ice at 253°K, and the diffusion lengths of neutrons were determined. Steady-state spectra in heavy ice assemblies at 77, 21, and 4°K were also investigated. The results for the effective neutron temperatures and the cold-neutron fractions agree well with the experimental results of Rush et al. (14 figures, 5 tables) (auth)

15786 ELASTIC ELECTRON-DEUTERON SCATTERING AS A PROBE OF THE DEUTERON WAVE FUNCTION. Coester, F.; Ostebee, A. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 11: No. 5, 1836-1848 (May 1975).

Relativistic corrections to the electric deuteron form factors are rederived within the framework of particle quantum mechanics. In addition to the kinematic corrections there are necessarily dynamic corrections that are substantially larger. For local potentials the results are identical to those derived by Gross from field theory. The reasons for the agreement of two apparently very different theories are examined in detail. The quantitative aspects of these results are illustrated by several numerical examples. A precise measurement of the polarization cross section for $q^2 < 13$ fm^{-2} could serve to significantly restrict the shape of admissible deuteron wave functions. (auth)

15787 FINAL-STATE INTERACTIONS IN THE ^{2}H(d,pp)nn REACTIONS. Warner, R. E.; Di Cenzo, S. B. (Oberlin Coll., Ohio (USA)); Ball, G. C.; Davies, W. G.; Ferguson, A. J.; Foster, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Phys., A; 243: No. 2, 189-201 (19 May 1975).

Absolute coincidence cross sections for the ^{2}H(d,pp)nn reaction were measured at E_d = 23.15 MeV by detecting both protons at a small included angle to observe events with small p–p and n–n relative energies (ϵ_{pp} and ϵ_{nn}). Evidence for a double final-state interaction was obtained at (θ_1 = 18°, θ_2 = 36°) and (25°, 43°), where the yields were elevated above phase space at low ϵ_{nn} and depressed below phase space at low ϵ_{pp}. Watson–Migdal predictions, using accepted values of the effective range parameters for the singlet p–p and n–n interactions, gave reasonably good fits to the data except for the ϵ_{nn} spectrum at (25°, 43°), which required an n–n scattering length $a_{nn} < -50$ fm. Acceptable fits were also obtained with a double distorted-wave theory using computed p–p and n–n scattering wave functions, a Gaussian transition potential and Slaus–Van Oers deuteron wave functions. (auth)

15788 STUDY OF PARITY-VIOLATING EFFECTS IN THE NEUTRON CAPTURE n+p → d+γ. Desplanques, B. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 242: No. 3, 423-428(5 May 1975).

The polarization and asymmetry of γ-rays emitted in the capture of thermal neutrons have been calculated for several strong and weak nucleon-nucleon potentials. The wave functions used in this calculation for the initial and final states, which contain a parity admixture, have been determined by solving the Schrödinger equation. (auth)

15789 REPLY: WHAT CAN WE LEARN FROM THREE-BODY REACTIONS? Haftel, M.I.; Petersen, E.L. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Rev. Lett. 34: No. 23, 1480-1481 (9 June 1975).

This reply gives the reasons that Brayshaw's criticism of our model should not invalidate our conclusions. (auth)

15790 COMMENT: WHAT CAN WE LEARN FROM THREE-BODY REACTIONS? Brayshaw, D. D. (Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachussets 02139). Phys. Rev. Lett.; 34: No. 23, 1478-1479 (9 Jun 1975).

It is pointed out that serious flaws in the models considered by Haftel and Petersen in their recent Letter preclude both a comparison with previous work by this author, and any direct relevance to N–d scattering experiments. (auth)

15791 ON CALCULATING SCATTERING PHASE SHIFTS BY THE GENERATOR COORDINATE METHOD. Beck, R.; Borysowicz, J.; Brink, D. M.; Mihailovic, M. V. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., A; 244: No. 1, 58-66(2 Jun 1975).

The generator coordinate equations for scattering phase shifts are solved for α–α scattering. Calculations are made in the coordinate representation and the results agree well with those obtained by a more laborious procedure which is formulated in the momentum representation. The results disagree with another calculation in the coordinate representation, where the scattering boundary condition is introduced less accurately. (auth)

15792 DISCRETE AMBIGUITIES IN PHASE-SHIFT ANALYSIS. Heemskerk, A. C.; Kok, L. P.; de Roo, M. (Rijksuniversiteit Groningen (Netherlands). Instituut voor Theoretische Natuurkunde). Nucl. Phys., A; 244: No. 1, 15-33(2 Jun 1975).

In two practical examples (α–^{3}He and α–α scattering), an investigation is made on the extent to which the elastic amplitude above the first inelastic threshold, determined from phase-shift analysis, is subject to ambiguity. It is found that it is extremely difficult to determine the correct physical amplitude uniquely. (auth)

15793 VALUE OF THE AXIAL-VECTOR COUPLING CONSTANT $g_{A,p}$ FROM MUON NUCLEAR CAPTURE EXPERIMENTS IN HYDROGEN, DEUTERIUM, AND HELIUM. Vitale, A. (Istituto di Fisica dell'Università di Bologna, and Istituto Nazionale di Fisica Nucleare, Sezione di Bologna, Italy); Bertin, A.; Carboni, G. Phys. Rev. D 11: No. 9, 2441-2448 (1 May 1975).

The results of muon capture experiments in hydrogen, deuterium, and ^{3}He were analyzed by comparing the observed capture rates to their theoretical expressions. From each experimental result, assuming the conserved-vector-current hypothesis, an allowed region of variation was obtained for the possible pairs of the axial-vector ($g_{A,p}$) and induced pseudoscalar ($g_{P,p}$) coupling constants. Assuming $g_{P,p}$ as given by one-pion exchange dominance, a limited range of variation for $g_{A,p}$ was then derived from each experimental result. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 13885, 15827, 15882, 15950, 15967, 15970, 15984, 15986, and 16011.

15794 (JINR-P4-8597) TOTAL BINDING ENERGY OF SPHERICAL NUCLEI. Vagradov, G. M.; Gareev, F. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The total binding energy of nuclei is determined by means of the many-body field theory. The problem is then reduced to finding the energy-dependent average potential (mass operator) and solving single-particle equations of motion. Such a potential can be established phenomenologically on the basis of data on low excitations and reactions of knocking out of nucleons from deep "hole" levels. The calculations of the total binding energy of nuclei ^{16}O, ^{40}Ca, ^{58}Ni with this potential are in satisfactory agreement with experiment. (1 table, 1 figure) (auth)

15795 FAST NEUTRON YIELDS AND SPECTRA FROM TARGETS OF VARYING ATOMIC NUMBER BOMBARDED WITH DEUTERONS FROM 16 TO 50 MeV. Meulders, J. P.; Leleux, P.; Macq, P. C.; Pirart, C. (Louvain Univ., Belgium). Phys. Med. Biol.; 20: No. 2, 235-243(Mar 1975).

Neutron production from targets of Be, C, Mo, Cu, Ta and Au bombarded with deuterons of 16, 33 and 50 MeV was studied at the isochronous cyclotron at Louvain-la-Neuve. Neutron spectra were measured by the time of flight method. The yields of neutrons and gamma rays were also measured, and the greatest ratio of neutrons to gamma rays in the forward direction was found to occur with 50-MeV deuterons on a Be target. The angular distribution of neutrons from Be was measured at 16, 33 and 50 MeV, and neutron spectra were measured as a function of angle with 50-MeV deuterons on Be. (auth)

15796 CONTRIBUTION OF COLLECTIVE EXCITATION OF NUCLEUS TO THE IMAGINARY PART OF THE OPTICAL POTENTIAL. Zhivopistsev, F. A.; Rzhevskii, E. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 6, 661-666(1974). (In Russian).

The angular and energy dependences of part of the optical potential, caused by inelastic processes with the excitation of lower collective states of the nucleus, were studied. A comparison was made with the Perey-Buck phenomenological nonlocal potentials. Calculated curves of the angular dependence were given for ^{12}C, ^{60}Ni, and ^{40}Ca. (JSR)

15797 MODEL DEPENDENCE OF π⁻-^{12}C SCATTERING NEAR THE 3-3 RESONANCE. Nakano, K.; Wu, C. S. (University of Victoria, Victoria, British Columbia, Canada). Phys. Rev. C 11: No. 5, 1505-1513(May 1975).

The elastic and inelastic scatterings of π^- by ^{12}C are calculated from the π-nucleon scattering matrix of the Chew model which fits the π-nucleon P_{33} phase shift data up to about 200 MeV. The results are compared with those calculated from the Kisslinger and Landau-Tabakin models to study the off-shell dependence of the π-nucleus scattering. (auth)

15798 ELECTROEXCITATION OF LOW-LYING STATES IN ^{19}F. Oyamada, M.; Terasawa, T.; Nakahara, K. (Laboratory of Nuclear Science, Tohoku University, Tomizawa, Sendai 982, Japan); Endo, Y.; Saito, H.; Tanaka, E. Phys. Rev. C 11: No. 5, 1578-1592 (May 1975).

Strong *E*2, *E*3, *E*4, and *E*5 excitations of low-lying states in ^{19}F were observed in an electron scattering experiment. From the measured form factors the following radiative transition strengths to the ground state (in Weisskopf units) were extracted: $|M(E2)|^2 = 8.1 \pm 1.0$ (the 1.55-MeV $3/2^+$ state), 1.0 ± 0.2 (4.56-MeV $5/2^+$); $|M(E3)|^2 = 11 \pm 3$ (1.35-MeV $5/2^-$), 15 ± 4 (5.43-MeV $7/2^-$); $|M(E4)|^2 = 5.8 \pm 1.3$ (2.78-MeV $9/2^+$); and $|M(E5)|^2 = 16 \pm 7$ (4.03-MeV $9/2^-$). A fairly large transverse form factor was found for the 2.78-MeV $9/2^+$ state. The value of B ($M5$, $9/2^+ \rightarrow$ g.s.) $= (3.0 \pm 1.2) \times 10^4$ e^2 fm^{10} was extracted from the experimental data on the assumption that this transverse form factor resulted from $M5$ excitation only. The experimental form factors and radiative transition strengths for positive-parity states are compared with theoretical values calculated using the rotation-particle coupling (RPC) model; good agreement is obtained for the states predominantly belonging to the ground-state band: the 0.197-MeV $5/2^+$, 1.55-MeV $3/2^+$, and 2.78-MeV $9/2^+$ states. It is found that RPC is essential, in particular, to the $E4$ and $M5$ transitions of the 2.78-MeV $9/2^+$ state. The $E3$ transition strength of the 5.43-MeV $7/2^-$ state, as well as the 1.35-MeV $5/2^-$ state, is comparable with that of the octupole-vibrational state at 6.13-MeV in ^{16}O. (auth)

15799 SIMPLE POTENTIAL MODEL FOR CLUSTER STATES IN LIGHT NUCLEI. Buck, B. (Department of Theoretical Physics, Oxford University, 12 Parks Road, Oxford, England); Dover, C.B.; Vary, J.P. Phys. Rev. C 11: No. 5, 1803-1821 (May 1975).

We present a simple model for three- and four-particle cluster states in light nuclei. These states are considered as bound states and single-particle resonances of a cluster-core potential, which is obtained by folding the cluster and core mass densities. We calculate some properties of these states in ^{16}O and ^{20}Ne, such as the rms radii, B ($E2$) values, α-decay widths, and energy spectra. Good agreement with available data is obtained, and some predictions are made for B ($E2$) values in the $K^\pi = 0^-$ bands in ^{16}O and ^{20}Ne. This model is also used to interpret recent heavy-ion three-particle-transfer data. Dynamical support is offered for high spin assignments in ^{15}N and ^{15}O previously based on kinematical considerations. (auth)

15800 CONTINUUM SHELL-MODEL CALCULATION OF THE ELECTRIC QUADRUPOLE STRENGTH IN ^{12}C. Birkholz, J. (Institut für Kernphysik der Technischen Hochschule Darmstadt, D61 Darmstadt, Germany). Phys. Rev. C 11: No. 5, 1861-1863 (May 1975).

A continuum shell-model calculation of the $E2$ strength in ^{12}C is presented in which an $E2$ resonance at $\sim$27 MeV excitation energy is predicted. The results are consistent with experimental data on photoproton angular distributions and polarizations. (auth)

15801 PARITY NONCONSERVATION IN THE 110-keV $1/2^- \rightarrow 1/2^+ \gamma$ TRANSITION IN ^{19}F. Box, M.A. (Department of Theoretical Physics, University of Sydney, Sydney, New South Wales, Australia 2006; McKellar, B.H.J. Phys. Rev. C 11: No. 5, 1859-1860 (May 1975).

We present the results of a calculation of the recently measured asymmetry of the 110-keV γ ray emitted in the $1/2^- \rightarrow 1/2^+$ transition in ^{19}F. Our results, for the usual choice of parity-nonconserving potential, are consistent with the observed asymmetry. (auth)

15802 INTERACTION POTENTIAL BETWEEN TWO ^{16}O NUCLEI DERIVED FROM THE SKYRME INTERACTION. Brink, D. M. (Oxford Univ. (UK). Dept. of Theoretical Physics); Stancu, F. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Phys., A; 243: No. 1, 175-188(12 May 1975).

The energy functional for the Skyrme density-dependent force is used to calculate the interaction potential between two ^{16}O nuclei. A two-centre harmonic oscillator potential is employed to construct the density and kinetic energy density of the ground state of the combined system and of the separated nuclei. The anti-symmetrization effects are investigated. The relative motion of the nuclei is taken approximately into account, and the energy dependence of the potential derived from the Skyrme force is presented. (auth)

15803 STUDY OF $^{11}B(p,p')$ IN A CORE-HOLE COUPLING SCHEME. Cavaignac, J. F.; Jang, S.; Worledge, D. H. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Nucl. Phys., A; 243: No. 2, 349-364(19 May 1975).

Angular distributions for the scattering of 30-MeV protons from ^{11}B for the 0, 2.12, 4.44, 5.02, 6.74 + 6.79, 7.30, 8.00, 8.57 and 9.19 + 9.27 MeV levels have been measured with a diborane gas target. The inelastic scattering for the first four excited levels has been analyzed in a microscopic distorted-wave Born approximation. Core-hole coupled wave functions derived from the $K = 1/2$ and $K = 3/2$ band mixing have been used to describe these ^{11}B levels. The form factors have been calculated using the long-range part of the Kallio–Koltveit interaction, and the exchange contributions have been included via a pseudo-potential approximation. (auth)

15804 POLARIZATION OF ^3He ELASTICALLY SCATTERED FROM ^{12}C AT 28 MeV AND THE SPIN-ORBIT COUPLING. Bond, C. D.; August, L. S.; Shapiro, P.; McGarry, W. I. (Naval Research Lab., Washington, D. C. (USA)). Nucl. Phys., A; 241: No. 1, 29-35(31 Mar 1975).

The polarization angular distribution of ^3He elastically scattered from ^{12}C at 28 MeV has been measured using the double scattering method. The ^3He polarization reached -28% at $\theta_{c.m.} = 47°$. An optical model analysis of the polarization and differential cross section requires a spin–orbit potential of $\sim$ 4 MeV to fit the data over the angular range of 12.5° c.m. to 72.5° c.m. This spin–orbit potential is higher than the theoretical prediction for simple constituent-nucleon coupling. (auth)

15805 ONE-BOSON-EXCHANGE POTENTIAL AND THE GROUND STATE OF ^{16}O. Machleidt, R.; Faessler, A. (Bonn Univ. (F. R. Germany)); Muether, H. (Vrije Universiteit, Amsterdam (Netherlands)). Nucl. Phys., A; 241: No. 1, 18-28(21 Mar 1975).

Two one-boson-exchange potentials (OBEP), which fit two-nucleon data and give reasonable results in nuclear matter, are tested in ^{16}O. Ground-state properties are calculated in the framework of the Brueckner–Hartree–Fock approach. The density dependence of the reaction matrix elements stemming from the Pauli operator and starting energy are carefully taken into account. (auth)

15806 HEAVY-ION ONE-NEUTRON TRANSFER REACTIONS INVOLVING ^{13}C. I. Spectroscopic Factor Products. Seiler, H. P.; Kulessa, R.; Cockburn, P. M.; Marmier, P. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik); Barker, P. H. (Auckland Univ. (New Zealand). Dept. of Physics). Nucl. Phys., A; 241: No. 1, 151-158(31 Mar 1975).

The total cross sections of some heavy-ion one-neutron transfer reactions involving ^{13}C, which lead to excited states of one of the final nuclei, have been measured at energies below the Coulomb barrier. Products of the neutron spectroscopic factors in the initial and final states have been extracted using a Coulomb wave Born approximation, and have been compared with theory. (auth)

15807 HEAVY-ION ONE-NEUTRON TRANSFER REACTIONS INVOLVING ^{13}C. II. Electromagnetic Lifetimes. Seiler, H. P.; Kulessa, R.; Cockburn, P. M.; Marmier, P. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik); Barker, P. H. (Auckland Univ. (New Zealand). Dept. of Physics). Nucl. Phys., A; 24: No. 1, 159-169(31 Mar 1975).

Heavy-ion one-neutron transfer reactions have been used to populate levels in ^{11}B, ^{14}C, ^{15}N and ^{20}F. The electromagnetic lifetimes of these levels have been measured using a form of the Doppler shift attenuation method. (auth)

15808 SURFACE REFLECTION PROPERTIES OF HEAVY ION OPTICAL POTENTIAL. Gelbke, C. K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Z. Phys.; 271: No. 4, 399-407(Dec 1974).

9 figs.; 1 tab.; 24 refs.

The reflection coefficients for various heavy-ion potentials are calculated in an approximation which includes a wave mechanical surface reflection term in addition to the semiclassical WKB-term. For potentials which are deep and strongly absorbing in the interior of the potential well reflection from the surface gives the dominant contribution to the reflection coefficients with small angular momenta. For shallow potentials these two terms are still not sufficient for the calculation of the reflection coefficients, indicating that higher order reflections are important. (auth)

15809 THE DECAY PROCESS $_\Lambda{}^{11}B \rightarrow \pi^+ {}^{11}C$. Zieminska, D. (Warsaw Univ. (Poland)). Nucl. Phys., A; 242: No. 3, 461-466(5 May 1975).

The branching ratios are calculated for $_\Lambda{}^{11}B$ decay to the $_\Lambda{}^{11}C$ ground and excited states below 8 MeV for two possible spin values of $_\Lambda{}^{11}B$. It is found that the decay rate to the $^{11}C^*$ state at $E^* = 6.48$ MeV is comparable in magnitude to that leading to the ^{11}C ground state if $J\,(_\Lambda{}^{11}B) = 5/2$ is assumed. This result, unlike the branching ratios calculated for the $J(_\Lambda{}^{11}B) = 7/2$ case, is in accord with experiment and lends support to the assumption that $J = 5/2$ holds for $_\Lambda{}^{11}B$. The necessity of the reinterpretation of some of the so-called $_\Lambda{}^{13}C$ events in terms of $_\Lambda{}^{11}B \rightarrow \pi^- + {}^{11}C^*$ is indicated. (auth)

15810 WIDTHS OF THE 6.32 AND 9.16 MeV LEVELS IN ^{15}N. Kim, J. C.; Caplan, H. S.; Auer, I. P. (Saskatchewan Univ., Saskatoon (Canada). Saskatchewan Accelerator Lab.). Phys. Lett., B; 56: No. 5, 442-444(26 May 1975).

The longitudinal and transverse electron scattering form factors of the first two $5/2^-$ states of ^{15}N were measured from $q = 0.5$ to 1.1 fm^{-1}. The ground-state radiative widths and transition radii of these states were deduced and compared with recent theoretical predictions. (auth)

15811 SELF-CONSISTENT AVERAGE MATRICES AND THE STRUTINSKY ENERGY THEOREM. Brack, M.; Quentin, P. (Niels Bohr Institutet, Copenhagen (Denmark)). Phys. Lett., B; 56: No. 5, 421-423(26 May 1975).

For nuclei ranging from ^{16}O to ^{208}Pb and for the Skyrme III effective interaction, it is shown that the sum of the average energy plus the first order shell correction reproduces perfectly well the exact Hartree-Fock energy, if the average density matrices are calculated self-consistently. (auth)

15812 OPTICAL-MODEL ANALYSIS OF N+C AND C+C ELASTIC SCATTERING. Delic, G. (Nuclear Physics Laboratory, Oxford, England). Phys. Rev. Lett. 34: No. 23, 1468-1471 (9 June 1975).

Two direct search methods have been applied to extract the optimum optical-model parameters for the elastic scattering of ^{14}N by $^{12,13,14}C$, ^{12}C by $^{13,14}C$, and ^{13}C by ^{14}C for center-of-mass energies in the range 7.8 to

12.6 MeV. The success of the analysis suggests that it is possible to interpret these data in terms of an optical-model potential alone, indicating that such experiments do not provide unambiguous evidence for interference between the elastic-scattering and elastic-transfer modes. (auth)

15813 MEASUREMENT OF THE QUADRUPOLE MOMENT OF ^{8}Li BY USE OF A POLARIZED DEUTERON BEAM AND NMR DETECTION. Minamisono, T.; Hugg, J.W.; Mavis, D.G.; Saylor, T.K.; Lazarus, S.M.; Glavish, H.F.; Hanna, S.S. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 34: No. 23, 1465-1468 (9 June 1975).

Polarized ^{8}Li nuclei ($T_{1/2}$=0.84 sec), produced in ^{7}Li(d,p)^{8}Li with polarized deuterons, were implanted in a thick $LiIO_3$ crystal used as the target. The asymmetry in the β decay of ^{8}Li was used to detect NMR in a strong magnetic field. About 1/3 of the ^{8}Li nuclei found Li substitutional sites where the polarization persisted for $T_1 \simeq 11$ sec. The quadrupole moment of ^{8}Li was determined from a knowledge of the electric field gradient in $LiIO_3$. (auth)

15814 A STUDY OF THE REACTION $^{12}C(\alpha,\alpha')^{12}C$ EXCITING THE 1^+ T = 0 LEVEL AT 12.71 MeV. Cecil, F. E.; Peterson, R. J. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Phys. Lett., B; 56: No. 4, 35-338(12 May 1975).

The differential cross section for the excitation in the inelastic scattering of 36-MeV α particles of the 1^+ T = 0 level in ^{12}C has been measured. Calculated angular distributions suggest that the transition proceeds primarily by two-step reactions rather than by the one-step reaction involving the two-body alpha-nucleon spin-orbit potential. (auth)

15815 PROTON REACTIONS WITH ^{17}O. I. Elastic and Inelastic Scattering Reactions. Crinean, G. B.; Wild, L. W. J.; Spicer, B. M. (Melbourne Univ., Parkville (Australia). School of Physics). Nucl. Phys., A; 244: No. 1, 67-76(2 Jun 1975).

Differential cross sections for the elastic and inelastic scattering of protons by ^{17}O have been measured at 8.62, 9.45 and 10.5 MeV. Excitation functions at 110° and 140° were measured from 8.5 to 10.5 MeV. The elastic scattering angular distributions were used to find optical model parameters for the scattering. The angular distributions of inelastically scattered protons were analyzed using the effective interaction method of Satchler, and also with the microscopic theory of Geramb and Amos. (auth)

15816 PREDICTION OF THE HIGH-SPIN SELECTIVITY OF COMPOUND REACTIONS INDUCED BY HEAVY IONS. Klapdor, H. V.; Rosner, G.; Reiss, H.; Schrader, M. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Phys., A; 244: No. 1, 157-188(2 Jun 1975).

Two procedures are described to predict the selectivity of heavy-ion (HI) compound reactions for excitation of high spins. The applicability of statistical-model calculations in respect to yrast line effects is discussed. Contour diagrams of total cross sections are derived, yielding and gradient $d\sigma(E,I)/dI$ and the peak to "background" ratio of high-spin states as well as the "optimum Q-value" for any given HI compound reaction. The dependence of both the optimum Q-value and the shape of $d\sigma(E^*)/dE^*$ on the critical L-value at high bombarding energies can be used to determine L_{crit}. This is demonstrated for the reaction $^{12}C + ^{14}N \rightarrow ^{26}Al$. A rougher estimate of the selectivity is given by the "grazing-collision picture" which is based on a consideration of the angular momentum balance. Using the reactions $^{10}B(^{12}C,d)$, $^{12}C(^{12}C,d)$, $^{12}C(^{14}N,d)$, $^{11}B(^{14}N,p)$, $^{13}C(^{14}N,p)$, $^{10}B(^{14}N,\alpha)$ and $^{12}C(^{14}N,^{6}Li)$ as examples, the theoretical predictions are shown to be in excellent agreement with experiment, for bombarding energies ranging between 40 and 120 MeV. The possibility to predict the high-spin selectivity is the precondition for an application of HI compound reactions for investigations of yrast lines and converts this class of reactions into an outstanding means for spectroscopy of high-spin states in light nuclei. (auth)

15817 VIBRATIONS AND POLARIZATIONS IN A CLUSTER MODEL DESCRIPTION OF STATES IN ^{12}C AND ^{16}O. Bargholtz, C. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., A; 243: No. 3, 449-460(26 May 1975).

The α-particle model of Bloch and Brink is used to study the importance of vibrations and of polarization of the clusters in low-lying states of ^{12}C and ^{16}O. The two effects are found to be approximately of the same importance for the binding energy. (auth)

15818 THE $1\hbar\omega/2\pi$ SPECTRA OF MASS 15, 16 AND 17 NUCLEI. Hsieh, S. T.; Knoepfle, K. T.; Mairle, G.; Wagner, G. J. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Phys., A; 243: No. 3, 380-394(26 May 1975).

Tamm-Dancoff calculations including the complete 1p and 2s–1d shells are presented for non-normal parity states of nuclei with mass 15, 16 and 17. The basis is confined to $1\hbar\omega/2\pi$ excitations. Spurious states have been eliminated. The particle-particle and hole-hole interactions were taken from previous work. The particle-hole interaction was represented by 80 matrix elements from Kuo, eight of which were varied to fit 30 selected levels with a rms deviation of 310 keV. Spectroscopic factors and electromagnetic transition rates generally agree quite well with the experimental data. It is shown that the inclusion of the $1p_{\frac{1}{2}}$ and $1d_{\frac{5}{2}}$ shells is essential even at low excitation energies in these nuclei. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 13721, 13885, 15796, 15799, 15808, 15882, and 15984.

15819 (SUNI-37, pp 15-16) TRANSFER REACTIONS INDUCED BY 38 MeV ^{19}F IONS ON ^{27}Al. McMurray, W. R.; Conlon, T. C.; Hooton, B.; Ivanovich, M. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15820 MECHANISM OF THE INELASTIC SCATTERING 9.6-MeV PROTONS ON ^{27}Al. Kozlowski, T.; Moroz, Z.; Ratynski, W.; Szymczak, M.; Wojtkowska, J. (Inst. of Nuclear Research, Swierk, Poland). Acta Phys. Pol., Ser.; B6: No. 2, 309-316 (1975).

Differential cross sections for $^{27}Al(p,p')^{27}Al$ were measured at 9.6 MeV in the range 25 to 150° for the inelastic proton groups corresponding to 17 excited states of Al. The energy resolution was about 70 keV. It is shown that, similarly to the results obtained previously for 9-MeV neutrons, DWBA + Hauser–Feshbach calculation does not reproduce the experimental angular distributions nor can it explain the observed CN reduction factors. Possible reasons for the observed discrepancies are discussed. (auth)

15821 RESONANCE FLUORESCENCE OF GIANT MAGNETIC DIPOLE STATES IN ^{24}Mg. Berg, U.E.P.; Wienhard, K.; Wolf, H. (Institut für Kernphysik, Strahlenzenthrum, Justus Liebig-Universität, D-63 Giessen, Federal Republic of Germany). Phys. Rev. C 11: No. 5, 1851-1853 (May 1975).

γ-ray resonance fluorescence of three magnetic dipole states in ^{24}Mg at 9827 ± 3, 9967 ± 3, and 10711 ± 3 keV was observed using bremsstrahlung and a 100-cm^3 Ge(Li) detector. The measured intensity ratios to the first excited state and the ground state were found to be $0.28^{+0.26}_{-0.19}$, $0.45^{+0.16}_{-0.13}$, and $0.23^{+0.07}_{-0.06}$, respectively. Integrated scattering cross sections and decay widths of these levels were determined relative to the known $^{16}O(\gamma,x\gamma')$ cross section. (auth)

15822 ELECTROMAGNETIC PROPERTIES OF LOW-LYING ^{26}Mg STATES. Wagner, P.; Ali, M.A.; Coffin, J.P.; Gallmann, A. (Laboratoire de Physique Nucléaire de d'Instrumentation Nucléaire, Centre de Recherches Nucléaires et Université Louis Pasteur, Strasbourg, France). Phys. Rev. C 11: No. 5, 1622-1633 (May 1975).

Levels in ^{26}Mg have been excited in the $^{26}Mg(\alpha,\alpha'\gamma)^{26}Mg$ reaction at E_α = 16 MeV. Angular correlation and Doppler shift attenuation methods have been used to measure γ-ray branching ratios, mixing ratios and life-times of bound states up to E_x = 6.9 MeV. Values or limits for the transition probabilities for 11 states have been deduced. The data are used to revise the structure of the $K^\pi = 2^+$ and 3^+ rotational bands. These bands consist of the following states E (MeV), J^π: for $K^\pi = 2^+$, 2.94 (2^+), 4.35 (3^+), 5.72 (4^+); for $K^\pi = 3^+$, 3.94 (3^+), 5.47 (4^+). (auth)

15823 STUDY OF $^{20}Ne(p,t)^{18}Ne$ TRANSITIONS WITH THE COUPLED-CHANNEL BORN APPROXIMATION. Olsen, D.K.; Udagawa, T. (Center for Nuclear Studies, University of Texas, Austin, Texas 78712); Brown, R.E. Phys. Rev. C 11: No. 5, 1557-1566 (May 1975).

Differential cross sections have been measured at a proton bombarding energy of 39.8 MeV for $^{20}Ne(p,t)$ transitions to the 0_1^+, 2_1^+, and 4_1^+ states of ^{18}Ne at 0.0, 1.89, and 3.38 MeV, respectively, and to the $(0_2^+, 2_2^+)$ doublet in ^{18}Ne at (3.58, 3.62) MeV. These cross sections are compared with zero-range coupled-channel Born-approximation calculations in which the coexistence-model wave functions of Benson and Flowers have been used. The inclusion of inelastic effects improves the agreement between experiment and theory; however, the calculated (p,t) cross sections are quite sensitive to the nature of the inelastic processes in the $t + ^{18}$Ne channel, and, until these processes are better understood, it is not possible for the calculation to provide a sensitive test of the mass-18 nuclear wave functions used. (auth)

15824 FRACTIONATED SINGLE-PARTICLE STATES OF ^{33}S AT E_x = 8.6–9.5 MeV. Liljestrand, R.; McIntyre, J.; Blanpied, G.; Lynch, J.; Ray, L.; Coker, W.R.; Hoffmann, G.W. (Department of

Physics, University of Texas, Austin, Texas 78712). Phys. Rev. C 11: No. 5, 1570-1577 (May 1975).

A total of 21 states of ^{33}S in the region of excitation from about 8.6 to 9.5 MeV have been studied using the reaction $^{32}S(d,p)$ at 12 MeV incident deuteron energy and a biased quadrupole spectrometer. Fractionated single-particle states are identified via their forward-angle cross sections, using distorted-wave Born-approximation predictions with resonance state form factors for the residual ^{33}S system. Results are compared with those from (n,n) and/or (n,γ) studies over the same region of excitation, where this is possible. It is shown that states strongly populated in (n,n) do not often show up in (d,p) spectra, and vice versa. (auth)

15825 *E*1 AND *E*2 STRENGTH IN ^{24}Mg AND ^{26}Mg OBSERVED IN α-CAPTURE REACTIONS. Kuhlmann, E.; Ventura, E.; Calarco, J.R.; Mavis, D.G.; Hanna, S.S. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. C 11: No. 5, 1525-1536 (May 1975).

Excitation functions and angular distributions of the reactions $^{20,22}Ne(\alpha,\gamma_0)$ were used to study the distribution of *E*2 strength in the energy regions 14–22 MeV of $^{24,26}Mg$, as well as to probe the importance of isospin in the decay of the *E*1 giant resonance in these nuclei. It was found that the *E*2 strength in the (γ,α_0) channel is rather uniformly distributed and accounts for about 10% of the energy-weighted sum rule in each nucleus. Together with the *E*2 strength observed in lower resonances, about 45% of the sum rule is accounted for. No evidence for a compact *E*2 resonance is found. A comparison of the *E*1 distribution and total strength in the (γ,α_0) channel of the giant dipole resonances in $^{24,26}Mg$ indicates that isospin conservation may be important in these reactions. Information was also obtained on the reactions $^{20,22}Ne(\alpha,\gamma_1)$. (auth)

15826 COMPLETE FUSION OF HEAVY IONS WITH ^{27}Al. Kozub, R.L.; Lu, N.H.; Miller, J.M.; Logan, D. (Department of Chemistry, Columbia University, New York, New York 10027); Debiak, T.W.; Kowalski, L. Phys. Rev. C 11: No. 5, 1497-1504 (May 1975).

Cross sections for evaporation residues following complete fusion have been measured for the bombardment of ^{27}Al with 81-, 105-, 126-, and 168-MeV ^{16}O, 138- and 210-MeV ^{20}Ne, and 336-MeV ^{32}S. The results were obtained using a counter telescope and, in some cases, differ considerably from previous work with mica track detectors. The experimental critical angular momenta for fusion are in good agreement with recent theoretical calculations for the O and Ne bombardments. Our data suggest parameters for the critical distance of approach which are significantly smaller than previously reported values. (auth)

15827 HIGH-SPIN STATES IN ^{20}F. Bishop, J.N.; Fortune, H.T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. Lett. 34: No. 21, 1350-1353 (26 May 1975).

Results of the reaction $^{14}N(^7Li,p)^{20}F$ identify several levels below 5 MeV as candidates for high-spin states predicted by shell-model calculations, but heretofore undiscovered. The 2.97-MeV level is found to be a doublet. (auth)

15828 RESONANCE STRENGTH MEASUREMENTS IN THE $^{24}Mg(p,\gamma)^{25}Al$ REACTION. Trautvetter, H. P. (Toronto Univ., Ontario (Canada)). Nucl. Phys., A; 243: No. 1, 37-43(12 May 1975).

The strength $\omega\gamma$ of the E_p = 823 keV resonances in $^{24}Mg(p,\gamma)^{25}Al$ was determined to be $\omega\gamma = 490 \pm 70$ meV, by comparison with the Rutherford cross section measured in the energy region of E_p = 600–800 keV. The strength of other low-lying resonances at E_p = 224, 419, 1483, 1623, 1654 and 2010 keV were determined relative to this new value. (auth)

15829 GAMMA RADIATION FOLLOWING HEAVY ION REACTIONS. Dauk, J.; Lieb, K. P. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik); Kleinfeld, A. M. (Koeln Univ. (F. R. Germany). 1. Physikalisches Inst.). Nucl. Phys., A; 241: No. 1, 170-188(31 Mar 1975).

The gamma radiation produced by bombarding ^{27}Al and ^{28}Si targets with 25–50 MeV ^{16}O ions was measured in order to study the formation and decay of the highly excited compound nuclei ^{43}Sc and ^{44}Ti. The relative population of the evaporation residues is fairly well reproduced by a statistical theory describing the successive emission of 1-3 light fragments. From the measured branching ratio between proton and α-particle emission, the moment of inertia parameter of the level density is found to be close to the rigid body value. The influence of heavy ion optical transmission factors, level density parameters and γ-ray decay widths of continuum states is investigated. (auth)

15830 DIRECT CAPTURE IN THE $^{24}Mg(p,\gamma)^{25}Al$ REACTION. Trautvetter, H. P.; Rolfs, C. (Toronto Univ., Ontario (Canada)). Nucl. Phys., A; 242: No. 3, 519-532(5 May 1975).

Excitation functions for the $^{24}Mg(p,\gamma)^{25}Al$ capture reaction have been obtained for the beam energy range E_p = 0.2-2.3 MeV. The analysis of these data revealed the presence of the direct capture process to the low-lying states in ^{25}Al at $E_x(J^\pi)$ = 0($\frac{5}{2}^+$), 452($\frac{1}{2}^+$), 945($\frac{3}{2}^+$), 2485($\frac{1}{2}^+$) and 3062 keV ($\frac{3}{2}^-$). The presence of the weaker direct capture transitions is manifested through interference effects on the tails of the two broad resonances at E_p = 823 and 1623 keV. The deduced spectroscopic factors for these final states in ^{25}Al are compared with the corresponding values from stripping data as well as model calculations. An astrophysical S-factor of S(0) on the order of 30 keV · b for this reaction has been obtained. (auth)

15831 STUDY OF TRANSFER REACTIONS INDUCED BY 0-16 IN THE NUCLEI ^{36}Ar, ^{38}Ar, ^{40}Ar AND ^{40}Ca. Braun-Munzinger, P. Heidelberg; Heidelberg, Univ. (1972). 58p. (In German). INIS.

Thesis.

Oxygen-16 induced transfer reactions with the nuclei ^{36}Ar, ^{38}Ar, ^{40}Ar, and ^{40}Ca were studied at a beam energy of 45 MeV. For the scattering experiments with Ar-Isotopes a gas target especially suited for reactions with heavy ions was developed. The outcoming particles were identified by a modified telescope method, with which—besides the energy loss and energy—the time of flight between the semiconductor detectors could be measured. Angular distribution and the coarse spectrum structure were interpreted in a semi-classical frame as well as with a DWBA method taking into account the recoil effect. The nuclear structure dependence of the (^{16}O, ^{12}C) reaction was discussed using the shell and quartet model. The reaction mechanism of the (^{16}O, ^{12}C) reaction was studied with respect to contributions to the cross sections, taking compound nucleus formation into account. (auth)

15832 OBSERVATION OF RESONANCES IN ^{24}Mg AT 32-40 MeV EXCITATION ENERGY VIA THE $^{12}C(^{12}C, ^8Be)^{16}O$ REACTION. Eberhard, K. A.; Mathiak, E.; Stettmeier, J.; Trombik, W.; Weidinger, A.; Wuestefeld, L. N.; Bernhardt, K. G. (Muenchen Univ. (F. R. Germany). Sektion Physik). Phys. Lett., B; 56: No. 5, 445-448(26 May 1975).

Strongly correlated resonances are observed in $^{12}C(^{12}C,^8Be)^{16}O$ excitation functions at $E_x(^{24}Mg)$ = 32.4 and 39.4 MeV for various excited states in ^{16}O. At these energies correlated structures are also present in $^{12}C(^{12}C,\alpha)^{20}Ne$ and $^{10}B(^{14}N,\alpha)^{20}Ne$ excitation functions as reported recently by other workers. (auth)

15833 TRANSIENT FIELD MEASUREMENTS OF G-FACTORS FOR ^{28}Si AND ^{30}Si. Eberhardt, J. L.; Horstman, R. E.; Doubt, H. A.; van Middelkoop, G. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Nucl. Phys., A; 244: No. 1, 1-14(2 Jun 1975).

Transient field precession measurements have been performed on the first excited 2^+ states of ^{28}Si and ^{30}Si with the IMPAC technique on recoil in magnetized iron. The results were analyzed with empirically adjusted Lindhard-Winther predictions. This → g-factors of $g = +0.56 \pm 0.09$ and $g = +0.56 \pm 0.16$ for ^{28}Si and ^{30}Si, respectively. In the present cases the influence of static hyperfine fields is negligible due to the very short mean lives for ^{28}Si and ^{30}Si of 0.68 and 0.35 ps, respectively. The results are compared with theoretical calculations. Previous results for $^{26}Mg_1^{2+}$ were reanalyzed with a more recent lifetime value of 0.72 ± 0.03 ps. The value of the g factor becomes $g = +0.82 \pm 0.16$. (auth)

15834 THE MEAN-LIFE AND MAGNETIC MOMENT OF THE FIRST EXCITED STATE OF ^{20}O. Berant, Z.; Broude, C.; Engler, G.; Hass, M.; Levy, R.; Richter, B. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Nucl. Phys., A; 243: No. 3, 519-527(26 May 1975).

The 2^+ first excited state of ^{20}O was excited by the reaction $^3H(^{18}O,p)^{20}O$. Using the recoil distance method, a decay curve with hyperfine interaction effects has been observed. The energy of the state, the mean lifetime, and the value of |g| have been measured. Comparison is made with shell model calculations. (auth)

15835 ANOMALOUSLY LARGE TRANSIENT FIELD THROUGH POLARIZED ELECTRON CAPTURE. Eberhardt, J. L.; Middelkoop, G. van; Horstman, R. E.; Doubt, H. A. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Phys. Lett., B; 56: No. 4, 329-331(12 May 1975).

The measured precession for $^{28}Si(2_1^+)$ recoiling into magnetized Fe shows an anomalous increase with initial recoil velocity. This is explained quantitatively by capture of polarized Fe electrons into 2s vacancies in the moving ion. (auth)

15836 PROTON REACTIONS WITH ^{17}O. II. The $^{17}O(p,d)^{16}O$ Reaction. Crinean, G. B.; Hudson, G. M.; Wild, L. W. J.; Spicer, B. M. (Melbourne Univ., Parkville (Australia). School of Physics). Nucl. Phys., A; 244: No. 1, 77-92(2 Jun 1975).

Differential cross sections for the $^{17}O(p,d_0)^{16}O$ reaction have been measured at the incident proton energies 8.62, 9.56, 10.5, 11.16

and 11.44 MeV. Both the BHMM and DWBA theories have been applied to these data, and to published analyzing power data for the reactions $^{16}O(d,p_0)^{17}O$ and $^{16}O(d,p_1)^{17}O^*$. While some parameter adjustment is necessary to obtain good fits with the BHMM theory, the adjusted parameters produce predictions in good agreement with analyzing power data. The DWBA theory, however, produces good fits with proton parameters deduced from measurements of proton elastic scattering from ^{17}O, provided the deuteron parameters used give good predictions for both differential cross section and vector analyzing power data for the reaction $^{16}O(d,d_0)^{16}O$. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 13721, 15794, 15808, 15829, 15831, 15865, 15868, 15870, 15887, 15966, 15985, and 16040.

15837 (CEA-CONF-2968) $^{56}Fe(d,n)^{57}Co$ REACTIONS AND ^{57}Co LEVELS. Adam, A.; Bersillon, O.; Joly, S. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). 1974. 13p. (CONF-7409106-1). Dep. NTIS (US Sales Only) $4.00.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

The (d,n) reaction on a natural Fe target has been studied at 6.0 and 8.0 MeV deuteron bombarding energies using the neutron time-of-flight technique with an overall time resolution of 2 ns. Angular distributions of neutrons leading to states in ^{57}Co were measured between 20° and 100°. The measured cross sections were analyzed in the framework of the DWBA theory to deduce l_p values and proton spectroscopic factors. For the lowest bombarding energy, the compound nucleus mechanism was taken into account. The results are compared with the corresponding data from (^{3}He,d) and other (d,n) studies. (2 tables, 2 figures) (auth)

15838 (CEA-CONF-2969) (n,2n) AND (n,3n) CROSS-SECTION MEASUREMENTS BETWEEN THRESHOLD AND 15 MeV. Frehaut, J.; Mosinski, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1974. 8p. (CONF-7409106-3). Dep. NTIS (US Sales Only) $4.00.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

The (n,2n) and (n,3n) cross-sections for several nuclei have been measured from the threshold up to 15 MeV incident neutron energy, using the large liquid scintillator method and the 12 MeV Tandem Van de Graaff accelerator of Bruyères-le-Châtel as a pulsed neutron source. The (n,2n) and (n,3n) cross-sections have been normalized to the fission cross-section of ^{238}U and are obtained with a relative accuracy of 5% to 10%. (1 table, 1 figure) (auth)

15839 (CEA-CONF-2971) GAMMA-RAY PRODUCTION CROSS SECTIONS FOR THE $^{56}Fe(n,n'\gamma)$ REACTION FROM 2.5 TO 14.1 MeV NEUTRONS ENERGIES. Lachkar, J.; Sigaud, J.; Patin, Y.; Haouat, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). 1974. 11p. (CONF-7409106-6). Dep. NTIS (US Sales Only) $4.00.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

Differential production cross sections for γ rays from the $^{56}Fe(n,n'\gamma)$ reactions are presented for incident neutron energies between 2.5 and 14.1 MeV. The excitation functions of 17 γ-ray transitions were measured between 4.8 and 8.8 MeV incident energies in nine 0.5 MeV steps, and at an angle of 90 deg. Angular distributions were also measured of 13 prominent γ rays at 8.8 MeV neutron energy and for the 846.8 keV and 1238.3 keV γ rays at 2.5 and 14.1 MeV neutron energies. Comparisons with previously published measurements and with the calculated cross sections of the Hauser-Feshbach formalism are presented. The agreement renders unnecessary the added contribution from a supposed continuum-like spectrum of unresolved final states. Such contribution has been proposed in previous studies. (3 figures) (auth)

15840 (CEA-N-1746, pp 29-30) PERTURBED DIFFERENTIAL ANGULAR CORRELATIONS WITH ^{57}Fe. Benski, H. C.; Berthier, J. 1974. (In French).

In first semi-annual progress report 1974. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

The perturbed differential angular correlation method allowed the fastest Larmor precessions of the 14.4-keV level in ^{57}Fe to be determined using fast discriminators with noise rejection. A hyperfine field H(hf) = −331.3 ± 2.6kOe was obtained in an iron matrix with a resolution of 3.85 n sec at full width at half-height. (auth)

15841 (KFK-2122) MEASUREMENT AND RESONANCE ANALYSIS OF DIFFERENTIAL ELASTIC SCATTERING CROSS SECTION OF ^{40}Ca. Toepke, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Dec 1974. 61p. (In German). Dep. NTIS (US Sales Only) $6.25.

Thesis. Submitted to Univ., Karlsruhe, Ger.

The set-up of a two-parameter scattering experiment at the neutron time-of-flight spectrometer of the Karlsruhe cyclotron is described. It enables the investigation of differential elastic scattering cross sections beyond the threshold for inelastic scattering by use of a neutron source with a continuous energy spectrum. Excitation functions at several angles can be measured simultaneously. Results are shown for ^{40}Ca in the energy range from 1 to 6 MeV for 10 angles between 20° and 150°. They are compared with data of other authors. Resonance parameters of about 100 levels in the compound nucleus ^{41}Ca were assigned by analyzing the total cross section and the resonance shape as function of the scattering angle. Based on these results, the strength functions for s, p and d waves were calculated. Within the quoted errors the present results agree with those of other authors. The predictions of the statistical model for the spin-dependent level density are compared with the experimentally determined values. The discrepancy found for spin J = 3/2 is discussed in the framework of the model. (13 figures, 5 tables) (auth)

15842 (SUNI-37, pp 9-11) LEVEL STRUCTURE, DECAY PROPERTIES, AND MEAN LIFETIMES OF LOW-LYING LEVELS IN ^{51}V, ^{55}Mn, AND ^{59}Co. van der Merwe, J. C.; Haupt, P.; Naude, W. J.; Rust, N. J. A.; Koen, J. W. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15843 (SUNI-37, pp 11-12) SPINS OF EXCITED STATES IN ^{51}V, ^{55}Mn, AND ^{59}Co AND MIXING RATIOS OF GAMMA TRANSITIONS IN ^{59}Co. Haupt, P.; van der Merwe, J. C.; Naude, W. J.; Koen, J. W.; Rust, N. J. A. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15844 (SUNI-37, pp 13) MAGNETIC MOMENTS OF LEVELS IN ^{51}V, ^{55}Mn, AND ^{56}Fe. van der Merwe, J. C.; Naude, W. J.; van Heerden, I. J. 1974.

In annual research report, 1974. Southern Universities, Nuclear Inst., Faure (South Africa).

15845 (USIP-74-27) EXPERIMENTAL E2/M1 MIXING RATIOS OF 2^{+}-2^{+} GAMMA TRANSITIONS IN EVEN-EVEN NUCLEI. Bargholtz, C.; Beshai, S.; Eriksson, L.; Gidefeldt, L. (Stockholm Univ. (Sweden). Fysiska Institutionen). Nov 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

E2/M1 mixing ratios of 2^{+}-2^{+} transitions in even-even nuclei have been determined by use of the gamma-gamma directional correlation method. The results were (energies in keV: $\delta(^{58}Fe;$ 863.6) = −0.86(4), $\delta(^{74}Ge,$ 608.5) = $2.5^{+0.7}_{-0.6}$, $\delta(^{122}Te,$ 686) = −3.50(5), $\delta(^{124}Te,$ 722.78) = −3.2(1), $\delta(^{132}Xe,$ 629.8) = 3.6(2), $\delta(^{186}Os,$ 630) = $-45^{+10}_{-\infty}$, and $\delta(^{198}Hg,$ 675.9) = 1.25(2). The following additional mixing ratios were obtained in ^{132}Xe: δ(1317.8) = −0.101(8), and δ(1135.6) = 0.40(5). The results are compared to estimates based on collective models. (18 figures, 4 tables, 44 references) (auth)

15846 INTERPRETATION OF ^{44}Ti AS A SOFT ASYMMETRIC ROTOR. Simpson, J.J. (Department of Physics, University of Guelph, Guelph, Ontario, Canada N1G 2W1); Dixon, W.R.; Storey, R.S. Phys. Rev. C 11: No. 5, 1828-1831 (May 1975).

The positive-parity levels in ^{44}Ti below 4.2 MeV and many of the $E2$ transitions between them are fairly successfully explained using a soft asymmetric rotor model. A brief discussion of suggested negative-parity states is also given. (auth)

15847 $E6$ TRANSITION IN ^{53}Fe. Gloeckner, D.H.; Lawson, R.D. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 11: No. 5, 1832-1835 (May 1975).

The $19/2^- \rightarrow 7/2^-$ $E6$ transition in ^{53}Fe is calculated in a model including all basis states of the configurations $(f_{7/2})^{13}\pi$ and $[(f_{7/2})^{12}\pi r' \times f_{5/2}]\pi$. Several interactions, which yield the observed amount of $f_{5/2}$ configuration mixing, have been considered. In all cases an effective charge $\delta \sim -0.4$ is needed to fit experiment (where $e_p = 1 + \delta$, $e_n = \delta$). (auth)

15848 PERTURBED ANGULAR DISTRIBUTION IN ^{53}Mn FOLLOWING RESONANT PROTON CAPTURE. Sie, S. H.; Frank, G. G.; Evans, H. C. (Queen's Univ., Kingston, Ontario (Canada)). Nucl. Phys., A; 243: No. 1, 1-8(12 May 1975).

The g-factor of the 378 keV ($5/2^-$) level in ^{53}Mn has been measured to be 1.30 ± 0.12 by an integral perturbed angular correlation method following a low energy recoil implantation into Ni by the $^{52}Cr(p,\gamma)^{53}Mn$ reaction. The result is consistent with a predominantly $(\pi f_{7/2})^{-3}$ configuration for the state. (auth)

15849 SPECTROSCOPY OF ^{42}Ca FROM ^{41}Ca(d,p). Hansen, O.; Lien, J. R.; Nathan, O.; Sperduto, A. (Niels Bohr Institutet, Copenhagen (Denmark)); Jjoem, P. O. (Oslo Univ. (Norway). Fysisk Institutt). Nucl. Phys., A; 243: No. 1, 100-124(12 May 1975).

Energy levels in ^{42}Ca up to 7.8 MeV have been studied in the neutron capture reaction ^{41}Ca(d,p)^{42}Ca at 12 MeV bombarding energy. Ninety-four excited states have been identified, and angular distributions have been measured in the interval from 5° to 110° by means of a broad-range magnetic spectrograph. The angular distributions together with DW calculations have been used to determine l_n values and spectroscopic factors. The $f_{\frac{7}{2}}$ strength sum agrees with shell-model expectations if the $f_{\frac{7}{2}}$ spectroscopic factors are renormalized by $^{1}/_{0.75}$, in line with other $f_{\frac{7}{2}}$ transfer experiments on ^{48}Ca and ^{41}Ca. A similar renormalization of the $l_n = 1$ spectroscopic factors brings this strength sum in accordance with the shell-model calculations. The effective $(f_{\frac{7}{2}})^2$ matrix elements for ^{42}Ca are compared with the corresponding matrix elements of ^{42}Sc and ^{46}Sc. The differences between the three sets of matrix elements are of the order of a few hundred keV or less. The monopole centroid energy of the $(f_{\frac{7}{2}})^2$ multiplet is shifted downwards in the mass-42 nuclei compared to ^{46}Sc, possibly indicating the importance of the monopole pairing force near ^{46}Ca. (auth)

15850 STATES IN ^{53}Mn FROM THE ^{52}Cr(p,γ)^{53}Mn REACTION. Schulte, R. L.; King, J. D.; Taylor, H. W. (Toronto Univ., Ontario (Canada)). Nucl. Phys., A; 243: No. 2, 202-214(19 May 1975).

Eight resonances have been observed in the ^{52}Cr(p,γ)^{53}Mn reaction between E_p = 0.90 and 1.03 MeV. Gamma-ray spectra have been accumulated at four of the resonances. Spin assignments have been made to the resonant states on the basis of the measured angular distributions of primary γ-rays. Excitation energies and γ-ray branching ratios have been determined for 36 levels between 2.0 and 5.6 MeV. Mean lives for nine of the states have been extracted by the Doppler shift attenuation method. (auth)

15851 $J^\pi = 0^+$ STATES IN THE (fp) SHELL EXCITED IN THE (^{3}He,n) REACTION. Alford, W. P.; Lindgren, R. A.; Elmore, D.; Boyd, R. N. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Nucl. Phys., A; 243: No. 2, 269-297(19 May 1975).

The (^{3}He,n) reaction has been used to study strongly excited 0^+ states in nuclei in the fp region. Measurements were made on targets of ^{46,48,50}Ti, ^{50,52,54}Cr, ^{54,56,58}Fe and ^{58,60,62,64}Ni at an energy of 15 MeV. In addition to the ground state transitions, L = 0 transitions to excited states were identified in all residual nuclei except ^{64,66}Zn. Many of the observed states can be identified as analogs of low-lying states in isobaric nuclei, and can be predicted by the pairing vibration model (PVM). In many cases, low-lying excited states are seen which are not predicted by this model. Present results are consistent with the view that these states represent fragments of the expected PVM state. A comparison of present results with available (p,t) data leading to the same final nucleus suggests that little mixing occurs between states with different PVM configurations. (auth)

15852 CROSS SECTIONS AND ISOMERIC RATIOS IN THE PHOTOPRODUCTION OF ^{44}Sc FROM HEAVIER NUCLEI. Eriksson, M.; Jonsson, G. G. (Lund Univ. (Sweden). Fysiska Institutionen). Nucl. Phys., A; 242: No. 3, 507-518(5 May 1975).

The yields and isomeric yield ratios in the photoproduction of ^{44}Sc from ^{45}Sc, ^{55}Mn, Fe, ^{59}Co and ^{75}As have been measured by activation methods in the energy region 100-800 MeV. Mean cross sections and isomeric cross section ratios in the energy region 250-800 MeV have been deduced and the number of valence neutrons available for the (γ,n) reaction estimated. The experimental cross sections are compared both to cascade-evaporation calculations based upon the free-nucleon photo-pion cross sections and to cross sections calculated with a semi-empirical formula. The isomeric cross section ratios are compared to calculations based on the statistical formalism by Huizenga and Vandenbosch together with cascade-evaporation theory. (auth)

15853 ^{39}K, ^{40}K AND ^{41}K NUCLEAR MAGNETIC RESONANCE STUDIES. Sahm, W.; Schenk, A. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Z. Naturforsch., A; 29: No. 12, 1754-1762(Dec 1974).

The NMR lines of ^{39}K and ^{41}K were investigated in solutions of many potassium salts in H_2O, D_2O, methanol and ethylenediamine and also in solid potassium halides. The NMR signal of the rare isotope ^{40}K was detected for the first time. The ratio of the Larmor frequencies of ^{39}K and ^{41}K was measured in various samples: $\nu(^{39}K)/\nu(^{41}K) = 1.821\ 873\ 1(9)$. No primary isotopic effect was to be detected within these limits of error (0.5 ppm). The concentration dependence of the chemical shift of the ^{39}K resonance frequencies was determined. Using this dependence, the ratios of the Larmor frequencies of the nuclei ^{39}K, ^{40}K, and ^{41}K for infinite dilution relative to the resonance frequency of ^{2}H in D_2O are given. The magnetic moments of the $^{39}K^+$, $^{40}K^+$, and $^{41}K^+$ ions purely surrounded by water molecules are presented without diamagnetic corrections. Comparison of these values with the results of atomic beam magnetic resonance experiments yields the hyperfine structure anomalies of all pairs of potassium isotopes and also the shielding of potassium nuclei by water molecules around the ions. (orig./HK)

15854 STUDY OF THE (p,n) CHARGE EXCHANGE REACTION ON NUCLEI OF THE (f,p) SHELL. Sperr, P. Muenchen, GE; Muenchen Univ. (1973). 59p. (In German). INIS.

Thesis.

With a neutron time-of-flight spectrometer the (p,n) direct reactions on ^{48}Ca, ^{50}Ti, ^{52}Cr, and ^{56}Fe were investigated and compared with (^{3}He,t) measurements on the same nuclei. Time-of-flights spectra were recorded at energies of 14 MeV and additionally at 17 MeV for ^{56}Fe over an angle region from 0 to 100°. The experimental angular distribution and the total cross sections of the isobaric analog states could be declared by the macroscopic DWBA analysis under application of a N-Z/A independent isospin potential. (auth)

15855 INVESTIGATION OF NUCLEI IN THE MASS REGION $50 < (N,Z) < 82$. Habs, D. Heidelberg; Heidelberg Univ. (1973). 192p. (In German). INIS.

Thesis.

New isotopes in the mass region $50 < (N,Z) < 82$ were produced by (α,xn) and (d,xn) reactions. For these isotopes the gamma radiation of the prompt decay and of the radioactive decay was investigated. For the following nuclides new level schemes could be found: ^{142,143,144}Gd, ^{142,143,144}Eu, ^{140,141}Sm, ^{138,139}Pm, ^{136}Nd, ^{135,136}Pr. The level schemes of the following nuclides could be supplied essentially: ^{142,143}Sm, ^{140,142}Pm and ^{137}Pr. (auth)

15856 DEVELOPMENT OF AN EQUIPMENT FOR THE COMPUTER CONTROLLED OPERATION OF AN ATOMIC-BEAM RESONANCE APPARATUS AND PRECISION MEASUREMENT OF THE NUCLEAR MAGNETIC DIPOLE MOMENT OF ^{39}K AND ^{41}K. Elke, D. Bonn; Bonn Univ. (1973). 93p. (In German). INIS.

Thesis.

The aspired precision measurements of the nuclear magnetic dipole moments of ^{39}K and ^{41}K require a retool of the present atomic-beam resonance apparatus for the on-line operation with a computer. The developed device for the remote control of the frequency decades and counters are described. Furthermore the characteristics of hf-power-resonators are given and their influence on the atomic resonance frequency. With this apparatus it was possible to accomplish precision measurements of the nuclear magnetic dipole moments of the alkali at magnetic fields of 3 kOe with a relative accuracy of 10^{-6}. (auth)

15857 ANGULAR CORRELATION STUDIES OF ISOBARIC ANALOG STATES IN ^{49}Sc VIA THE ^{48}Ca(τ,dp)^{48}Ca REACTION. Gales, S.; Fortier, S.; Laurent, H.; Maison, J. M.; Schapira, J. P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Phys. Lett., B; 56: No. 5, 449-452(26 May 1975).

A new method for studying the proton decay of isobaric analog states is proposed. The proton decay of highly excited analog states, populated by the (τ,d) reaction, is investigated using method II of Litherland and Ferguson. Spins and proton partial widths for transitions to the ground and excited states of the target are extracted by means of d-$\vec{p}$ angular correlation measurements. The method is illustrated by a study of analog states in ^{49}Sc. (auth)

15858 OPTIMUM Q-VALUES FOR THE ^{58}Ni(^{16}O,^{12}C) REACTION WELL ABOVE THE COULOMB BARRIER. Wilczynski, J.; Siwek-Wilczynska, K.; Larsen, J. S.; Acquadro, J. C.; Christensen, P. R. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., A; 244: No. 1, 147-156(2 Jun 1975).

The reaction ^{58}Ni(^{16}O,^{12}C) has been studied at three incident energies, 60, 72 and 81 MeV, for a wide range of scattering angles. The angular and energy dependence of the optimum Q-value has been determined from the data. A simple optimum Q-value model which combines the recoil model of Siemens et al. with a concept of nuclear friction is proposed. (auth)

15859 THE ISOSPIN FORBIDDEN $1^- \rightarrow 0^+$ TRANSITION IN ^{40}Ca. Gloeckner, D. H. (Rutgers—the State Univ., New Brunswick, N. J. (USA)); Lawson, R. D. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 56: No. 4, 301-304(12 May 1975).

The isospin forbidden transition 1^- (6.95 MeV) $\rightarrow 0^+$ (g.s.) in ^{40}Ca is explained within a model that mixes isospin through single-particle energy differences and the two-body Coulomb interaction. There is no need to introduce an isospin non-conserving part of the nucleon-nucleon interaction to explain this anomalously fast transition. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 13721, 15795, 15796, 15808, 15838, 15842, 15845, 15851, 15852, 15855, 15887, 15962, 15967, and 15985.

15860 (AED-CONF-74-042-023) MEASUREMENT OF THE CHANGE OF HALF-LIFE FOR ^{64}Cu IN DIFFERENT CHEMICAL STATES. Jenschke, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). 1974. 6p. INIS.

From spring meeting of the Fachausschuss Kernphysik und Hochenergiephysik of the Deutsche Physikalische Gesellschaft e.V.; Bochum, F. R. Germany (4 Mar 1974).

3 tabs.; 5 refs.

The element ^{64}Cu (12.82 h) is found to decay by electron capture more slowly in the chemical state of copper nitrate and copper sulfate solution than in copper metal. The deduced changes of electron densities at the nucleus are $(1.9 \pm 0.5)10^{-4}$ or $(2.6 \pm 0.5)10^{-4}$. The results are in the same order of magnitude as HFS-calculations for atomic copper relative to ionic copper but disagree considerably with earlier measurements. (auth)

15861 (GSI-tr-2-75) THE DESINTEGRATION OF THE LIGHTEST RUBIDIUM ISOTOPES. Bogdanov, D. D.; Voborzhil, I.; Demyanov, A. V.; Karnaukhov, V. A.; Petrov, L. A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Feb 1975. 4p. (In German). INIS.

1 fig.; 2 tabs.; 8 refs. Published in Izv. Akad. Nauk SSR. Translated from the Russian report JINR-P6-8497.

The mass separator BEMS-2 was used on-line at the heavy ion cyclotron of the JINR. From the irradiation of ^{50}Cr with ^{32}S, light rubidium isotopes were separated. The life times of ^{75}Rb and ^{76}Rb was determined more carefully and the γ-spectra accompanying the β-decay of these isotopes were measured. For ^{76}Rb a spin discrimination is given. (auth)

15862 (NP-20343, pp 51-55) ENERGY SPECTRA OF DELAYED NEUTRONS FROM ARSENIC-85. Franz, H.; Kratz, K. L.; Rudolph, W. 15 Jun 1974. (In German).

In annual report, 1973.

15863 (NP-20343, pp 55-60) ENERGY SPECTRA OF DELAYED NEUTRONS FROM BROMINE-87, BROMINE-88, AND IODINE-137. Nuh, F. (Univ. of California, Berkeley); Prussin, S. G.; Kratz, K. L.; Franz, H.; Tittel, G.; Klein, G. 15 Jun 1974. (In German).

In annual report, 1973.

15864 T_z-DEPENDENCE OF COULOMB DISPLACEMENT ENERGY. Rahman, M. A. (Atomic Energy Centre, Dacca, Pakistan); Rahman, M; Awal, M. A.; Khatun, S.; Gupta, H. M. S. Nuovo Cim., A; 25A: No. 2, 273-283(21 Jan 1975).

A least-squares analysis is carried out on all available data on Coulomb displacement energy ΔE_c as a function of Z/A. An attempt is also made to study quantitatively any possible T_z-dependence of ΔE_c; the dependence is found to be small. (auth) (5 tables, 5 figures)

15865 COMPOUND-NUCLEUS CONTRIBUTION TO (α,α') REACTIONS IN Ni, Zn, AND Sn. Alzona, J.E.; Chan, K.C.; Shabason, L.; Cohen, B.L. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 11: No. 5, 1669-1675 (May 1975).

A clean separation of compound nucleus from noncompound nucleus processes in (α,α') reactions is made for 18-MeV α particles on Ni, Zn, and Sn. Experimental results agree well with both Weisskopf and Hauser-Feshbach theory using Gilbert-Cameron level densities. In addition, a surprising theoretical prediction in the case of Ni is dramatically confirmed by experiment. (auth)

15866 STUDY OF THE ^{64}Ni$(p,t)^{62}$Ni REACTION. Kong-A-Siou, D.H.; Nann, H. (Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 11: No. 5, 1681-1690 (May 1975).

Energy levels in ^{62}Ni up to an excitation energy of 6.4 MeV have been studied by the ^{64}Ni$(p,t)^{62}$Ni reaction at 40 MeV bombarding energy with an over-all resolution of 12 keV full width at half maximum. Spins and parities are assigned to levels which were excited with characteristic angular distributions. These include 0^+ states at 2.05, 2.89, 4.23, 4.62, and 5.45 MeV. A distorted-wave analysis based on shell-model wave functions was performed and compared to the experimental differential cross sections. (auth)

15867 MEASUREMENTS OF THE ELECTRON-PHOTON DOUBLE DECAY IN ^{85}Rb AT 30°. Krečak, Z.; Ilakovac, K.; Jurčević, M. (Institute "Rudjer Bošković," Zagreb, Yugoslavia). Phys. Rev. C 11: No. 5, 1707-1711 (May 1975).

Measurements of the electron-photon double decay of the 514-keV state in ^{85}Rb have been performed at a relative angle of emission of 30° using a fast-slow double coincidence system with a three-dimensional analyzer. The energy spectra of photons and double-decay differential coefficients for $K\gamma$ decay and $(L + M + N)\ \gamma$ decay have been derived from the counting rates. The results are in agreement with the theory of the internal Compton effect of Spruch and Goertzel. (auth)

15868 BARRIER PENETRABILITY AND/OR DEFORMATION EFFECTS IN ^{35}Cl INDUCED FUSION ON ^{58,60,62,64}Ni. Scobel, W.; Mignerey, A.; Blann, M. (Department of Chemistry and Nuclear Structure, Research Laboratory, University of Rochester, Rochester, New York 14627); Gutbrod, H.H. Phys. Rev. C 11: No. 5, 1701-1706 (May 1975).

Excitation functions for complete fusion have been measured for ^{35}Cl projectiles on ^{58,60,62,64}Ni. Deviations from the predictions of the sharp cutoff model are observed and compared with calculations based on the formalism of Wong. In this picture tunneling and static deformation of target and projectile can explain the experimental data in the barrier region. (auth)

15869 ^{89}Y$(t,p)^{91}$Y REACTION AT $E_t = 20$ MeV. Preedom, B.M. (Department of Physics, University of South Carolina, Columbia, South Carolina 29208); Flynn, E.R.; Stein, N. Phys. Rev. C 11: No. 5, 1691-1700 (May 1975).

The reaction ^{89}Y$(t,p)^{91}$Y has been measured at an incident energy of 20 MeV. Differential cross sections were measured at 13 angles, and an excitation range of 5 MeV was observed with 18 keV resolution. The data are compared to distorted-wave calculations both for L assignments and magnitude relations. Sixteen new levels are reported in ^{91}Y as well as many new limits on spin assignments. An interpretation of the results as a proton hole coupled to ^{92}Zr pairing-multipole states is presented. Such an analysis provides a qualitative description of the observed strength, but a more complex analysis is required for quantitative results. (auth)

15870 INCLUSION OF "UPWARD" MIXING IN THE DETERMINATION OF ISOSPIN MIXING IN HIGHLY EXCITED NUCLEI. Porile, N.T. (Department of Chemistry, Purdue University, Lafayette, Indiana 47907); Grimes, S.M. Phys. Rev. C 11: No. 5, 1567-1569 (May 1975).

The formalism for the analysis of isospin mixing in the decay of compound nuclei has been reformulated to include "upward" mixing of the $T^<$ into $T^>$ states as well as usual "downward" mixing of $T^>$ into $T^<$. The ratio of isospin mixing parameters for these two processes, $\mu^\uparrow/\mu_\downarrow$ is evaluated for compound nuclei in the $A \sim 50$–70 region and is ~ 0.03. The mixing matrix element has an average value of $\sim 70 \pm 40$ eV in this mass region. (auth)

15871 STUDY OF ^{72}Ge WITH THE ^{71}Ga(^{3}He, d)^{72}Ge REACTION. Ardouin, D.; Tamisier, R. (Institut de Physique de Nantes, B.P. 1044, 44-Nantes, France); Berrier, G.; Kalifa, J.; Rotbard, G.; Vergnes, M. Phys. Rev. C 11: No. 5, 1649-1657 (May 1975).

The ^{71}Ga(^{3}He, d)^{72}Ge reaction has been studied at 25 MeV incident energy with a split-pole spectrometer. The over-all energy resolution was 18 keV. Sixty ^{72}Ge levels, 29 of which observed for the first time, were populated below 5.2 MeV excitation energy. Angular distributions were obtained from 5° to 63°, and comparison with distorted-wave–Born-approximation calculations allowed parity assignment and spin limits for 44 levels. Spectroscopic factors are deduced for most of the observed transitions. The whole $2p$-$1f$ and a weak part of the $3s$-$2d$-$1g$ strengths are observed. An interesting result is the strong population of the first excited 0^+ state at 0.690 MeV as compared to the ground state. We present a simple model which can account for this result. Possible $J^\pi = 0^+$ levels in ^{72}Ge are found at 2.029 and 3.614 MeV. (auth)

15872 STATES OF HIGH SPIN IN ^{87}Sr, ^{88}Sr AND ^{89}Sr. Arnell, S. E.; Stankiewicz, O. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik); Nilsson, A. (Research Institute for Physics, Stockholm, Sweden). Nucl. Phys., A; 241: No. 1, 109-134(31 Mar 1975).

The reactions ^{84}Kr(α,n), ^{86}Kr$(\alpha,3n)$, ^{86}Kr$(\alpha,2n)$ and ^{86}Kr(α,n) were used to populate excited states in ^{87}Sr, ^{88}Sr and ^{89}Sr. The de-excitation of these states was studied by in-beam γ-ray spectroscopy. A number of new high-spin states have been observed. Many ^{87}Sr and ^{89}Sr levels are interpreted as due to the coupling of a $g_{9/2}$ neutron hole and a $d_{5/2}$ neutron, respectively, to excited states of the core nucleus ^{88}Sr. Lifetime measurements have also been performed. (auth)

15873 ^{73}Ge: A NEW HIGH RESOLUTION MOESSBAUER NUCLIDE. Pfeiffer, L.; Raghavan, R. S. (Bell Labs., Murray Hill, N. J. (USA)). J. Phys. (Paris), Colloq.; No. 6, 203-208 (1974).

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

Experiments which demonstrate a recoilless resonance effect with the 13.3-keV transition (tau = 4.3 μs) in ^{73}Ge are reported. The effect was observed in powder microcrystals as well as in

single crystal materials. The sharpest ^{73}Ge resonance observed thus far has a FWHM linewidth of 14 ± 2 μm/s. This is the narrowest Moessbauer resonance observed so far at room temperature. (auth)

15874 TANGENTIAL FRICTION IN DEEP-INELASTIC SCATTERING OF ^{16}O FROM NICKEL. Albrecht, R.; Dünnweber, W.; Graw, G.; Ho, H.; Steadman, S.G.; Wurm, J.P. (Max-Planck-Institut für Kernphysik, Heidelberg, Germany). Phys. Rev. Lett. 34: No. 22, 1400-1403 (2 June 1975).

Bombarding Ni targets with 96-MeV ^{16}O ions, we have observed deep-inelastic groups of mass-16 and −12 reaction products with Q values centered at −30 to −35 MeV. From the multiplicity of the coincident γ de-excitation, total fragment spins and hence, using a classical model, orbital angular momentum transfers of 12ħ to 15ħ are deduced. These, and at least 50% of the energy dissipation, are ascribed to tangential friction. (auth)

15875 FISSION OF MEDIUM MASS ELEMENTS INDUCED BY 126 MeV ^{14}N IONS. Cabot, C.; Ngo, C.; Peter, J.; Tamain, B. (Paris-11 Univ., 91—Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 244: No. 1, 134-146(2 Jun 1975).

Ni, Se, Mo, Ag, Ho and Au targets were bombarded by 126 MeV ^{14}N ions in order to study compound nucleus fission. The large angular momentum brought in by the projectile implies much greater fission probabilities than those obtained when the same compound nuclei are created with light projectiles. Two surface-barrier detectors were used. The results obtained are fission cross sections, angular correlations and kinetic energy and mass distributions. Fissilities are found to decrease exponentially with the ratio Z^2/A of the fissioning nucleus until $Z^2/A = 19$ (molybdenum) and then to increase again for lower Z^2/A. The calculations of fissilities performed with the fission barrier of Myers and Swiatecki, and including angular momentum effects in evaporation-fission competition, gives the same variation of fissilities as the experimental one, but the results obtained are lower than the experimental values. The total kinetic energies measured are higher than the predictions of the liquid drop model by around 10 MeV (Nix). The shapes of the mass distributions indicate that the value of the Businaro-Gallone point is lower than 0.4 (silver). (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 13721, 14918, 15771, 15795, 15845, 15863–15865, 15869, 15875, 15907, 15913, 15922, and 15985.

15876 (NP-20343) ANNUAL REPORT, 1973. Weber, M. (comp.). (Mainz Univ. (F. R. Germany). Inst. fuer Anorganische Chemie und Kernchemie). 15 Jun 1974. 170p. (In German). Dep. NTIS (US Sales Only) $11.25.

This report deals with the following topics: performance of the Mainz TRIGA reactor and the mass separator of the Gesellschaft fuer Scherionenforschung, Darmstadt; rapid chemical separations and detection of short-lived nuclides; energy spectra of delayed neutrons, nuclear decay, and isomeric states; charge distributions in fission; problems in the detection of superheavy elements; development of ion sources and targets for mass separators for the study of neutron-rich nuclei; and activation analysis for the determination of Pb and examination of jewels. Lists of talks and publications are also included. Individual reports containing significant amounts of information are cited separately by title. (46 figures, 21 tables) (RWR)

For titles of individual papers see: 13719, 13720, 13788–13796, 14345, 14380, 15058, 15074, 15075, 15862, 15863, 15877–15882, 15908–15910, 15933, and 15934.

15877 (NP-20343, pp 18-23) NUCLEAR ISOMERISM OF NEUTRON-RICH NIOBIUM NUCLIDES. Ahrens, H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Kaffrell, N.; Trautmann, N. 15 Jun 1974. (In German).

In annual report, 1973.

15878 (NP-20343, pp 43-46) GAMMA SPECTRA OF SHORT-LIVED BARIUM, LANTHANUM, CERIUM, AND PRASEODYMIUM ISOTOPES. Seyb, K. E. 15 Jun 1974. (In German).

In annual report, 1973.

15879 (NP-20343, pp 60-64) STUDY OF SHORT-LIVED ANTIMONY NUCLIDES: NEUTRON SPECTRUM OF ANTIMONY-135. Rudolph, W.; Franz, H.; Kratz, K. L. 15 Jun 1974. (In German).

In annual report, 1973.

15880 (NP-20343, pp 65-68) DECAY OF TECHNETIUM-105. Suemmerer, K.; Kaffrell, N.; Trautmann, N. 15 Jun 1974. (In German).

In annual report, 1973.

15881 (NP-20343, pp 68-75) SEPARATION AND DECAY PROPERTIES OF SHORT-LIVED SILVER ISOTOPES FROM FISSION PRODUCTS. Bruechle, W. 15 Jun 1974. (In German).

In annual report, 1973.

15882 (NP-20343, pp 131-136) STUDY OF THE DECAY PROPERTIES OF NEUTRON-RICH NUCLEI AT THE ORSAY ON-LINE MASS SEPARATOR. Detraz, C. (Institut de Physique Nucleaire, Orsay, France); Dittner, P. F.; Klapisch, R.; Prieels, R.; Rigaud, C.; Roeckl, E.; Thibault, C. 15 Jun 1974. (In German).

In annual report, 1973.

15883 (SUNI-37, pp 3-4) LEVEL STRUCTURE OF ^{115}In FROM (n,n′γ) MEASUREMENTS. van Heerden, I. J.; McMurray, W. R. 1974.

In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15884 EXPERIENCE WITH APPLICATION OF HEURISTICAL PROGRAMS FOR THE ANALYSIS OF EXPERIMENTAL DECAY CURVES. Kindler, E.; Prouza, Z. (Charles Univ., Prague). pp 149-154 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Four heuristical programs are described which are used for the analysis of experimental decay curves. Variations in the results obtained using the four programs are discussed. (ERB)

15885 NEW ACCELERATOR LABORATORY OF THE NUCLEAR RESEARCH INSTITUTE. Results and Expectations. Koltay, E. (Nuclear Research Inst., Debrecen, Hungary). Fiz. Szemle; 24: No. 5, 134-144(May 1974). (In Hungarian).

During the last five-year plan period, considerable effort was spent on the broadening of the instrumental basis of the nuclear research carried out at the Institute. A new laboratory for the use of the Electrostatic Accelerator Department was completed in 1971. It is equipped with 1 and 5-MeV generators, providing high-energy tools for charged-particles research. The needed detecting instruments and data-processing equipment have been built and installed, and new detector systems were developed; the equipment needed for charged-particle, neutron and γ-spectroscopy is currently available. Experienced theoreticians and experimentalists have been transferred to the Department to provide its basic staff. Work is in progress on elastic proton scattering, the excitation function of the ^{40}Ca(p,p)^{40}Ca reaction, etc. The Institute's cascade generator was used to develop a detecting system for the track of charged particles in plastic foils by chemical etching for the study of the ^{27}Al(p,)^{28}Mg reaction. Microanalytical work involves detection of the presence of N on the basis of the ^{14}N(p,γ)^{15}O reaction during the nitriding of steel. Work is also in progress on the microanalytical application of elastic scattering. (TTT) (15 figures, 36 references)

15886 MICROSCOPIC INTERPRETATION OF INELASTIC PROTON SCATTERING FROM ^{138}Ba AND ^{144}Sm. Larson, D.; Austin, S.M.; Wildenthal, B.H. (Cyclotron Laboratory and Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 11: No. 5, 1638-1648 (May 1975).

Microscopic DWBA calculations for the (p, p') reaction at $E_p = 30$ MeV have been performed for 2^+, 4^+, and 6^+ states in ^{138}Ba and ^{144}Sm. Large-basis shell-model wave functions were used to describe the nuclear states. The effective two-body interaction mediating the inelastic scattering was obtained from a recent survey of inelastic scattering analyses. Polarization charges for the nucleons were extracted using a scheme based on the model of Atkinson and Madsen. Two sets of shell-model wave functions were employed for the ^{138}Ba calculation, and it was found that comparison of the inelastic proton scattering calculations with experiment clearly distinguished between the two sets. For the better wave functions, the polarization charges were essentially independent of state and multipole. (auth)

15887 PRECISION MEASUREMENT OF THE SHAPES OF THE FIRST-FORBIDDEN UNIQUE BETA SPECTRA: ^{42}K, ^{142}Pr, ^{86}Rb, AND ^{91}Y. Narasimha Rao, C.; Mallikarjuna Rao, B.; Mallikharjuna Rao, P.; Venkata Reddy, K. (Laboratories for Nuclear Research, Andhra University, Visakhapatnam-530003, India). Phys. Rev. C 11: No. 5, 1735-1739 (May 1975).

The shapes of the ground-state transitions of ^{42}K, ^{142}Pr, ^{86}Rb, and ^{91}Y were carefully measured in an intermediate-image β-ray spectrometer. The spectra were analyzed using exact electron radial wave functions of Bhalla and Rose. The measured shapes were compared to the theoretical predictions in terms of a linear fit of the form $(1 + aW)$ and a hyperbolic fit of the form $(1 + b/W)$. All the spectra were found to show a small-order deviation from the simple unique shape. The shape factor term in the analysis of ^{91}Y was found

to be $b = +0.027 \pm 0.007$. Some of the existing theoretical approaches in this direction have been discussed. (auth)

15888 LOW-SPIN ISOMER OF ^{127}Ba. Pathak, B.P.; Preiss, I.L. (Rensselaer Polytechnic Institute, Troy, New York 12181). Phys. Rev. C 11: No. 5, 1762-1766 (May 1975).

Neutron-deficient ^{127}Ba has been formed through the positron decay of its precursor ^{127}La produced by the ^{115}In(^{16}O, 4n)^{127}La reaction. The γ-ray spectra have been studied using thin-window intrinsic Ge and large-volume Ge(Li) detectors. In contrast to the results reported earlier, γ rays of energies (relative intensities) 66.0 (22 ± 2), 72.7 (9 ± 1), 114.8 (85 ± 5), 180.8 (100), 567.5 (2.9 ± 0.3), 577.6 (4.0 ± 0.4), 626.0 (2.2 ± 0.2), 682.0 (2.5 ± 0.3), 692.5 (2.8 ± 0.3), 1087.0 (4.4 ± 0.4), and 1203.0 (20 ± 2) keV have been observed to be associated with the decay of ^{127}Ba. The half-life of ^{127}Ba has been established as 13.0 ± 0.5 min by following the decay of the photopeaks of intense γ rays. The γ-γ coincidence spectra were studied using two Ge(Li) detectors and a two-parameter analyzer system. A revised decay scheme is proposed. (auth)

15889 γ-γ ANGULAR CORRELATIONS OF TRANSITIONS IN ^{142}Ce. Basinger, G.J.; Schick, W.C. Jr.; Talbert, W.L. Jr. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. C 11: No. 5, 1755-1761 (May 1975).

Angular correlation measurements have been performed on 12 direct and 4 skip cascades in ^{142}Ce, all involving the 641-keV $2^+ \rightarrow 0^+$ transition. The ^{142}Ce levels were populated in the β^- decay of fission-product ^{142}La produced as a decay product of ^{142}Xe at the TRISTAN on-line isotope-separator facility. Spin-parity assignments or preferences have been made for all 13 excited levels below 3 MeV previously known to be populated in this decay. In addition, a new 0^+ level is established at 2030 keV in ^{142}Ce. These levels are described in terms of vibrations of a spherical nucleus. An alternate interpretation in terms of quasirotational bands is also presented. (auth)

15890 EXPERIMENTAL STUDIES OF THE NEUTRON-DEFICIENT GADOLINIUM ISOTOPES: ^{145}Gd^{m1} AND ^{145}Gd^{m2}. Firestone, R.B.; Warner, R.A.; McHarris, W.C. (Department of Chemistry, Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824); Kelly, W.H. Phys. Rev. C 11: No. 5, 1864-1866 (May 1975).

An isomer in ^{145}Gd at 27.3 keV is reported with a half-life of 11.5 ± 0.3 nsec and an internal conversion coefficient $\alpha_L = 16.9 \pm 1.4$. This state is described as substantially the $\nu d_{3/2}$ single-neutron state which is fed by the ^{145}Gd^{m2} $\nu h_{11/2}$ isomer and which deexcites through the $\nu s_{1/2}$ ground state. The isomeric transition from ^{145}Gd^{m1} is found to be 99.2 ± 0.2% $M1$ + 0.8 ± 0.2% $E2$, indicating a hindrance factor of 100 in the $M1$ and an enhancement factor of 40 in the $E2$ over the single-particle estimates. Recent information on the $N = 81$ $11/2^-$ isomers is presented for ^{137}Te through ^{147}Dy showing the systematic changes in experimental energies and $M4$ matrix elements. (auth)

15891 REACTION MECHANISM OF TWO-NUCLEON TRANSFER BETWEEN HEAVY IONS. Goetz, U.; Ichimura, M.; Broglia, R. A.; Winther, A. (Niels Bohr Institutet, Copenhagen (Denmark)). Phys. Rep.; 16: No. 3, 115-167(Feb 1975).

A quantal formulation of the two-nucleon transfer process is given, and the basic coupled-channel equations are solved by iteration up to second order. The first order corresponds to simultaneous transfer, the second order to successive (sequential) transfer of two nucleons. Different representations of the T-matrix are derived. For the first order a post form and a prior form, which correspond to the representations of the DWBA, are obtained. For the second order several representations which give different decompositions into a pure successive and non-orthogonality term are derived. A semiquantal approximation is introduced which leads to a simplification of description and computation. The transfer amplitude for each partial wave is calculated in the semiclassical way and then a partial wave summation using the JWKB elastic phase shifts is performed. Numerical results obtained by this approximation show good agreement with quantal calculations for simultaneous transfer even above the Coulomb barrier, provided the attractive part of the optical potential is not too strong. The method is used for an investigation of the relative importance of the successive process in the reactions ^{94}Mo(^{18}O, ^{16}O)^{96}Mo and ^{208}Pb(^{16}O, ^{14}C)^{210}Po. It is found that the contributions from successive and simultaneous transfer have the same order of magnitude. (auth)

15892 ON THE USE OF LIOUVILLE RELAXATION SUPERMATRICES IN MOESSBAUER STUDIES. Hartmann-Boutron, F.; Spanjaard, D. (Paris-11 Univ., 91- Orsay (France). Lab. de Physique des Solides). J. Phys. (Paris); 36: No. 4, 307-314(Apr 1975).

In a previous paper, the Moessbauer spectrum in the presence of relaxation was related to a certain relaxation supermatrix R. A rigorous expression of R which is valid at arbitrary temperature is now derived and related to the relaxation supermatrix S which characterizes the relaxation of the density matrix of the radioactive atom. The general problem of lattice averaging in the computation of relaxation effects is discussed and as an illustration, the expression for the Moessbauer lineshape of an emitter is established. (FR)

15893 THE ELECTRIC QUADRUPOLE MOMENT OF THE 6^+ STATE OF ^{112}Sn. Vianden, R.; Krien, K.; Schmidt, H. U. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Nucl. Phys., A; 243: No. 1, 29-36(12 May 1975).

The spectroscopic quadrupole moment of the isomeric 6^+ (2552 keV) state of ^{112}Sn has been derived from TDPAD measurements in a Cd metal host target at 500 K as $Q_1(6^+, {}^{112}\text{Sn}) = \pm 0.29(6)$ b. The calibration of the effective field gradient for Sn in Cd at 500 K, given by Herrlander et al. has been used. A comparison of the results with shell model estimates makes a mixed configuration of $|(g_{7/2})^{-2}6^+\rangle$ and $|(g_{7/2}^{-1}d_{5/2}^{-1})6^+\rangle$ for the 6^+ state most likely. (auth)

15894 LEVEL STRUCTURE IN ^{117}Sb INVESTIGATED IN THE DECAY OF THE ISOMERIC-QUASIPARTICLE STATE. Fromm, W. D.; Brinckmann, H. F.; Doenau, F.; Heiser, C.; May, F. R.; Pashkevich, V. V.; Rotter, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Nucl. Phys., A; 243: No. 1, 9-28(12 May 1975).

The level structure of ^{117}Sb was investigated in the reactions ^{115}In(α,2nγ), ^{117m}Sb, ^{117}Sn(d,2nγ)^{117m}Sb and ^{117}Sn(p,nγ)^{117m}Sb. In order to confirm level sequences and to assign spins and parities to levels populated in the decay of the isomeric three-particle state ($T_{\frac{1}{2}} = 340$ μs), prompt and delayed γ-ray spectra, lifetimes, γ-γ coincidences, γ-ray angular distributions, conversion electrons and excitation functions were measured. The spin $25/2^+$ of the isomeric state can be explained by the three-particle configuration $[\pi(d_{5/2}); \nu(h_{11/2})^2\ 10^+]25/2^+$. This is supported by the experimentally determined g-factor of $g = 0.115 \pm 0.006$. Other levels in ^{117}Sb can be interpreted as particle states coupled to anharmonic vibrations of the core. The existence of an excited $3/2^+$[404] quasirotational band is experimentally proved and is supported by calculations of the equilibrium deformation. (auth)

15895 IN-BEAM STUDY OF ^{136}Ce AND ^{138}Nd ISOTONES WITH $N = 78$. Yoshikawa, N. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nucl. Phys., A; 243: No. 1, 143-154(12 May 1975).

Excited states in ^{136}Ce and ^{138}Nd have been investigated by means of in-beam spectroscopy with the (p,4nγ) reaction. Excitation functions and angular distributions of γ-rays were measured with a Ge(Li) detector, and conversion electron spectra were taken with a magnetic spectrometer. Time-dependent spectra of γ-rays revealed delayed components with half-lives of 2.2 μsec and 0.41 μsec in ^{136}Ce and ^{138}Nd, respectively. Most of the excited states are classified as belonging to the quasi-ground-state rotational band and the quasi-gamma band. Negative-parity 5^- and 7^- states were also observed. (auth)

15896 NUCLEAR STRUCTURE STUDY OF THE ISOMERS OF ^{102}Rh BY NUCLEAR ORIENTATION. Schoeters, E.; Geerts, R.; Silverans, R. E.; Vanneste, L. (Louvain Univ. (Belgium)). Nucl. Phys., A; 243: No. 2, 309-316(19 May 1975).

The nuclear magnetic moments of the two isomers of ^{102}Rh have been measured using nuclear orientation at low temperatures. The results are $|\mu| = 0.45 \pm 0.35$ n.m. for the 206-d isomer and $|\mu| = 4.11 \pm 0.15$ n.m. for the 1057-d isomer. Strong evidence has been found for spin-parity assignments $I^\pi = 2^-$ for the former and $I^\pi = 6^+$ for the latter. All results are interpreted following the jj coupling model, and definite conclusions can be made about the nature of both states. (auth)

15897 DEUTERON D-STATE EFFECTS FOR THE REACTIONS ^{117}Sn(d(pol),p)^{118}Sn AND ^{119}Sn(d(pol),p)^{120}Sn. Knutson, L. D.; Thomson, J. A.; Meyer, H. O. (Wisconsin Univ., Madison (USA)). Nucl. Phys., A; 241: No. 1, 36-46(31 Mar 1975).

Angular distributions of the differential cross section and the three tensor analyzing powers were measured for the reactions ^{117}Sn($\vec{d}$,p)^{118}Sn and ^{119}Sn($\vec{d}$,p)^{120}Sn at $E_d = 12$ MeV. In addition, excitation functions of the tensor analyzing power T_{20} were measured at proton lab angles of 0° and 5° for energies ranging from 10 to 12 MeV. At forward angles, the tensor analyzing powers for the ground state ($l_n = 0$) transitions are more than an order of magnitude larger than the predictions of distorted-wave calculations which neglect the deuteron D-state. Qualitative agreement with the measurements is obtained when the D-state is included. (auth)

15898 SPECTROSCOPY OF ^{70}Ga USING THE ^{69}Ga(d,p)^{70}Ga AND ^{71}Ga(d,t)^{70}Ga REACTIONS. Dohan, D. A.; Summers-Gill, R. G. (McMaster Univ., Hamilton, Ontario (Canada). Tandem Accelerator Lab.). Nucl. Phys., A; 241: No. 1, 61-78(31 Mar 1975).

The reactions ^{69}Ga(d,p) and ^{71}Ga(d,t) have been studied with 5

to 10 keV resolution. Altogether, 49 energy levels were observed in ^{70}Ga up to an excitation of 2 MeV and spectroscopic information for 41 of them has been obtained by DWBA analysis of their differential cross sections. From a comparison of the l = 1 spectroscopic strengths, as seen in (d,p) and (d,t), we make a tentative distinction between $p_{\frac{1}{2}}$ and $p_{\frac{3}{2}}$ neutron transfer. Most of the latter strength lies in the ground and 508 keV states which are populated in agreement with the 2J + 1 rule for spins 1^+ and 2^+ respectively. Spins are also suggested for the levels most strongly populated with l = 3 and l = 4 angular distributions. Among the lower states, that at 691 keV is notable because of its small cross section and this may mean that it is based on an excited proton configuration. (auth)

15899 TRIAXIAL SHAPES IN LIGHT La NUCLEI. Butler, P. A.; Meyer-ter-Vehn, J.; Ward, D.; Bertschat, H.; Colombani, P.; Diamond, R. M.; Stephens, F. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Phys. Lett., B; 56: No. 5, 453-456(26 May 1975).

Lifetimes for the lowest $^{15}/_2^-$ and $^{19}/_2^-$ states in ^{129,131}La were measured. Values for the reduced transition probabilities compared with those in neighboring even nuclei can be understood using a model that couples a rotation-aligned $h_{\frac{11}{2}}$ proton to a triaxial core. (auth)

15900 THE 1^-(2.48 MeV β^-)0^+ TRANSITION FROM ^{148}Pm, THE IAS PROCESS AND THE NUCLEAR STRUCTURE OF THE GROUND STATES INVOLVED. Szybisz, L. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Nucl. Phys., A; 244: No. 1, 107-116(2 Jun 1975).

The β-moments of the 1^-(2.48 MeV β^-)0^+ transition in the decay of ^{148}Pm have been derived from the experimental data available. These phenomenological results have been used to propose the ^{148}Pm ground state configuration in the framework of the two-quasiparticle model. It is confirmed that the high ft value is due rather to the smallness of the individual β-moments than to a strong cancellation effect. The β-moment ratio is discussed in detail. The present results are compared with values provided by the IAS process. (auth)

15901 LEVEL STRUCTURE OF ^{103}Ru STUDIED BY THE ^{100}Mo(α,n)^{103}Ru REACTION. Klamra, W. (Research Institute for Physics, Stockholm, Sweden); Rekstad, J. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., A; 243: No. 3, 395-412(26 May 1975).

The energy level structure of ^{103}Ru was studied by means of the ^{100}Mo(α,n)^{103}Ru reaction. The experiments included measurements of the γ-ray yield as a function of projectile energy, γ-γ coincidence measurements, γ-ray angular distributions and lifetime measurements. Two $\Delta I = 2$ cascades proceeding to the $^7/_2^+$ and $^{11}/_2^-$ states were observed. It is concluded that the nucleus has a prolate shape in the $^{11}/_2^-$ state. (auth)

15902 ALPHA-PARTICLE AND PROTON SCATTERING FROM EVEN MASS MOLYBDENUM ISOTOPES. Burger, S. J. (University of Fort Hare, Alice, South Africa); Heymann, G. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.). Nucl. Phys., A; 243: No. 3, 461-491(26 May 1975).

Angular distributions of α-particles and protons elastically and inelastically scattered from ^{92,94,96,98,100}Mo have been measured for 32 MeV incident α-particles and for 12 MeV incident protons. Levels up to the first 3^- state in each nucleus were studied in the proton spectra with a resolution of 50 keV (FWHM). A total of 62 states were analyzed in the α-particle spectra which were recorded up to 12 MeV excitation energy with a resolution (FWHM) of 100 keV. The highest energy up to which states were resolved was approximately 6 MeV in ^{92}Mo, decreasing to about 2.5 MeV in ^{100}Mo. Optical-model and single-step DWBA analyses were made. Spin and parity assignments as well as deformation lengths extracted from the present results are presented and compared with those obtained by other experiments. Transition rates inferred from the deduced deformation lengths are compared to theoretical estimates made for the octupole states. Evidence was found of states that may possibly be described as mixtures of one- and two-phonon excitations. (auth)

15903 RESULTS OF INVESTIGATIONS OF ISOTOPES FAR FROM THE β-STABILITY BAND. SUMMARY OF WORK ON THE YaSNAPP PROGRAM IN THE NUCLEAR PROBLEMS LABORATORY OF THE JOINT INSTITUTE FOR NUCLEAR RESEARCH. PART 1. Arlt, R.; Gromov, K.Y.; Zaitseva, N.G.; Kalinnikov, V.G.; Kracik, B.; Musiol, G.; Raiko, V.I.; Fenyes, T. Sov. J. Part. Nucl. 5: No. 4, 339-358 (Apr 1975).

We summarize the results of research on isotopes far from the β-stability band, carried out at the Nuclear Problems Laboratory of the Joint Institute for Nuclear Research in 1967–1973 by the YaSNAPP program. The methods of obtaining and investigating the isotopes are briefly described, and the results are presented and analyzed for spherical and transition nuclei: Z ~ 40 and N ~ 50; Z > 50 and N ≤ 82; Z = 81 and N ≤ 116; Z = 84–87 and N ≤ 126. (auth)

15904 PHOTO ACTIVATION OF INDIUM USING A 25-MeV BETATRON. Kuttemperoor, V. Z.; Kobiske, R. A. (Milwaukee School of Engineering). Int. J. Appl. Radiat. Isotop.; 26: No. 3, 138-141(Mar 1975).

Bremsstrahlung radiation from a 25 MeV betatron was used to activate an indium foil. The radiation analysis of the activated indium foil revealed that the isotopes ^{111}In, ^{112}In, ^{112m}In, ^{113m}In, ^{114m}In and ^{115m}In were created by photon activation and the isotope ^{116m}In by neutron activation. Both energy and half-life measurements were made, using a high resolution nuclear spectroscopy system, to identify the reactions responsible for the creation of the isotopes mentioned above. Gamma spectra of the activated indium, accumulated using a high resolution nuclear spectroscopy system, are shown graphically. (UK)

15905 DECOUPLED BANDS AND SHAPE COEXISTENCE IN NEUTRON DEFICIENT Gd NUCLEI. Kleinheinz, P. (Lawrence Berkeley Lab., CA); Sheline, R. K.; Maier, M. R.; Diamond, R. M.; Stephens, F. S. Nukleonika; 20: No. 2, 163-167(1975).

The (α, xn, γ) reaction on a series of odd and even Sm targets has been used to study the level structure of ^{147,149,151}Gd. Detailed results are given for ^{151}Gd. A variety of criteria show conclusively that in ^{151}Gd two bands with very different deformations are observed—one an $i_{13/2}$ decoupled band with small prolate deformation of $\beta = +0.14$, the other a normal rotational band with prolate deformation of $\beta = +0.29$ associated with the $h_{11/2}$ hole excitation. A simple explanation for these two different shapes, based on the Nilsson diagram, is presented. (3 figures) (auth)

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Refer also to abstracts 15795, 15811, 15838, 15845, 15875, 15878, 15905, and 15985.

15906 (EFI-54(74)) INVESTIGATION OF THE REACTION OF (γp) AT MAXIMUM ENERGY OF BREMSSTRAHLUNG PHOTONS OF 4.5 GeV. Alanakyan, K. V.; Yegiyan, K. Sh.; Ogandzhanyan, M. S.; Sharabyan, Yu. G. (Erevanskij Fizicheskij Inst. (USSR)). 1974. 13p. (In Russian). INIS.

A study is made of the dependence of the reaction yield for the photoformation of protons on complex nuclei as a function of the mass number of the target nucleus. The experimental data obtained by the method of a scintillation telescope at a maximum energy of incident bremsstrahlung photons of 4.5 GeV, secondary proton energies of 75 and 282 MeV, and emission angles of 46, 86 and 136° indicates that the dependence of the (γp) reaction yield as a function of the mass number of the target nucleus is different from an $A^{\frac{5}{6}}$ law is close to an A law. From this it can be concluded that first the interaction of photons with nuclei in this region of energies has a volume character, and second, the observed protons are mainly products of internuclear cascade processes. (SJR)

15907 (JINR-P7-8531) LIFETIMES OF HIGH-SPIN ROTATIONAL STATES OF ^{166}Yb. Bochev, B.; Kalpakchieva, R.; Karamian, S. A.; Kutsarova, T.; Nadjakov, E.; Subbotin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The lifetimes of the ground-band rotational levels of ^{166}Yb have been measured up to the high spin ($16^+\hbar$) values by a recoil-distance Doppler-shift method following ^{130}Te(^{40}Ar, 4n) reaction. The results are compared with those obtained when using the rigid rotor method. The information is presented on the reaction independent population of the ^{166}Yb rotational band states. (3 tables, 2 figures) (auth)

15908 (NP-20343, pp 46-50) NUCLEAR ISOMERISM OF TUNGSTEN-189. Schweden, F. J.; Kaffrell, N.; Trautmann, N. 15 Jun 1974. (In German).

In annual report, 1973.

15909 (NP-20343, pp 75-79) NUCLEAR ISOMERISM IN PROMETHIUM-154. Wirth, G. 15 Jun 1974. (In German).

In annual report, 1973.

15910 (NP-20343, pp 79-84) BETA DECAY OF ERBIUM-173 AND THULIUM-176. Dreisigacker, E.; Kaffrell, N. 15 Jun 1974. (In German).

In annual report, 1973.

15911 SCATTERING OF HIGH ENERGY ELECTRONS FROM ORIENTED NUCLEI IN EIKONAL APPROXIMATION. Sarkar, S.; Khatun, S. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., A (London); 7: No. 18, 2304-2317(11 Dec 1974).

Using the eikonal approximation, a general expression for the cross section for fast-electron scattering from oriented nuclei is given and a corresponding simpler expression for nuclei fully oriented along the direction of momentum transfer. The branching ratios of quadrupole transition probabilities to different rotational levels of aligned nuclei are also obtained. Using Petkov's analytic method for the Fermi charge density and taking different forms of nuclear charge distributions, the cross section and the effect of nuclear alignment on it are calculated in the eikonal approximation for electron scattering from oriented ^{165}Ho nuclei. The results are compared with those obtained by employing phase-shifted distorted waves and with experimental findings. The Born approximation limit of the above results is also obtained. A correction term is added to Petkov's result for the quadrupole transition probability. In the case when one assumes a δ function quadrupole distribution the effect of nuclear alignment, determined in the eikonal approximation, is compared with that obtained in the Schiff-Tiemann approximation. The variation of the above mentioned effect with the change in energy and sign of the charge of the projectile, the degree and direction of nuclear alignment is also investigated. (auth)

15912 TECHNIQUE FOR CALCULATION OF CONTINUUM PHOTON AND CONVERSION-ELECTRON PRODUCTION CROSS SECTIONS AND SPECTRA FROM NEUTRON-INDUCED REACTIONS. Perkins, S. T.; Haight, R. C.; Howerton, R. J. (Univ. of California, Livermore). Nucl. Sci. Eng.; 57: No. 1, 1-11(May 1975).

A formalism for the calculation of continuum gamma-ray production has been extended to include explicit parametric dependence on excitation energy and to calculate electron and x-ray production arising from internal conversion. Comparison with experiment is shown for both nonfissile and fissile materials. (11 figures, 1 table) (auth)

15913 NUCLEAR RAMAN SCATTERING OF 11.387-MeV PHOTONS BY DEFORMED HEAVY NUCLEI. Jackson, H.E.; Thomas, G.E. (Argonne National Laboratory, Argonne, Illinois 60439); Wetzel, K.J. Phys. Rev. C 11: No. 5, 1664-1668 (May 1975).

A beam of 11.4-MeV photons, extracted from the CP-5 reactor, has been used in a high-resolution measurement of the differential cross section for photon scattering by nuclei ranging from ^{141}Pr to ^{238}U. Inelastic scattering which leaves the residual nucleus in a state of the ground-state rotational band, i.e., nuclear Raman scattering, was measured relative to elastic scattering. The data confirm the trends observed earlier in measurements at 10.83 MeV. The strength of inelastic scattering has been compared with the predictions of simple models of the giant dipole resonance. The implication of deviations of measured cross sections from predictions of the simple rotator model are discussed. These discrepancies are significant in the lanthanide region and may be viewed as evidence for the existence of a small direct nonresonant reaction component in the region of the giant dipole resonance. (auth)

15914 SINGLE-PARTICLE STATES OF ^{173}Lu OBSERVED IN DECAY OF ^{173}Hf. Brenner, D.S.; Kishore, R. (Jeppson Laboratory, Clark University, Worcester, Massachusetts 01610); Meyer, R.A. Phys. Rev. C 11: No. 5, 1712-1718 (May 1975).

The level scheme of ^{173}Lu as populated by the decay of 23.9-h ^{173}Hf has been studied using Ge(Li) detectors in singles and coincidence γ-ray spectrometers. The coincidence data provide strong support for nearly all the previously proposed levels. Singles data obtained with a Compton-suppression spectrometer have enabled us to identify very weak transitions which were not seen by previous experimenters. Some of these transitions are used to establish new levels at 721.56, 734.63, 1359.32, and 1408.90 keV, and arguments are presented for assignment of these levels as the 1/2[660], 7/2[523], 3/2[402] + 3/2[651], and 1/2[400] Nilsson states. (auth)

15915 HIGH-SPIN ROTATIONAL STATES IN ^{169}Hf FROM THE ^{159}Tb(^{14}N, 4$n\gamma$) REACTION AND DECAY OF ^{169}Ta. Rezanka, I.; Ladenbauer-Bellis, I.M. (Heavy Ion Accelerator Laboratory, Yale University, New Haven, Connecticut 06520); Rasmussen, J.O.; Ribbe, W.; der Mateosian, E. Phys. Rev. C 11: No. 5, 1767-1785 (May 1975).

High-spin levels of the deformed nucleus ^{169}Hf were deduced from γ-ray spectroscopy, both in beam following the heavy-ion reaction ^{159}Tb(^{14}N, 4$n\gamma$)^{169}Hf and out of beam from β decay of ^{169}Ta. The half-life of ^{169}Ta was remeasured as 4.7 ± 0.7 m. Three rotational bands were assigned in ^{169}Hf: 5/2$^-$[523] ground band, up to spin 31/2; 5/2$^-$[512], 59.1 keV bandhead, up to spin 15/2; and 5/2$^+$[642], 7/2$^+$ bandhead at 28.80 keV, up to spin 41/2 and tentatively up to spin 49/2. The 7/2$^+$ bandhead of the 5/2$^+$[642] band is isomeric and decays with a half-life of 82^{+40}_{-15} ns to the ground state. The g factors in the negative-parity bands were deduced from the measured angular distributions and branching ratios and compared to the predictions of the Nilsson model. Both this test and the systematics of the moments of inertia confirm the proposed assignments. The 5/2$^+$[642] band (originating in the $i_{13/2}$ shell-model state) is strongly perturbed. This band does not backbend although the ^{168}Hf core does at a lower rotational angular momentum than attained in ^{169}Hf. The consequence of this observation for the explanation of backbending is discussed. The mixing amplitudes in the positive-parity band are compared with the predictions of Pyatov's theory. (auth)

15916 HYPERFINE INTERACTION OF ^{181}Ta IN CHROMIUM. Benski, H. C.; Berthier, J.; Teisseron, G.; Choulet, S. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). Phys. Lett., A; 51: No. 8, 467-469 (5 May 1975).

The hyperfine interaction of ^{181}Ta diluted in chromium was measured as a function of temperature by time-differential perturbed angular correlations. A quadrupole interaction which varies dramatically with temperature is present, superposing with a magnetic interaction below the Néel temperature. (auth)

15917 EXCITED STATES OF THE TRANSITIONAL ^{189}Ir AND ^{187}Ir NUCLEI POPULATED BY THE (α,2n) REACTION. Andre, S.; Boutet, J.; Rivier, J.; Treherne, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires); Jastrzebski, J.; Lukasiak, J.; Sujkowski, Z. (Institute of Nuclear Research, Warsaw (Poland)); Sebille-Schueck, C. (Centre National de la Recherche Scientifique, 91-Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). Nucl. Phys., A; 243: No. 2, 229-259(19 May 1975).

Enriched targets of ^{187}Re and ^{185}Re were bombarded with α-particles of energy between 23.0 and 42.8 MeV. The levels characteristic of ^{189}Ir produced by the (α, 2n) reaction were studied. The positive-parity bands built on the 3/2$^+$ ground state and on the 1/2$^+$ first excited state in both nuclei were observed and interpreted as bands built on the 3/2$^+$ [402] and 1/2$^+$ [400] Nilsson states. The negative-parity levels form two independent systems: the first one possesses characteristics typical of a rotation-aligned band and is interpreted as belonging to the h_9 orbital; the second one is connected with the 11/2$^-$ isomeric state which originates from the $h_{11/2}$ orbital. The possibility of a triaxial shape for this $h_{11/2}$ level system is discussed. In ^{189}Ir a 3.2-ms isomeric state of 2333 keV excitation energy has been found, and, as a by-product, some information has been gathered on the 4.1-ms isomer in ^{188}Ir. (auth)

15918 INELASTIC SCATTERING OF PROTONS BY RARE-EARTH NUCLEI. Kurepin, A.B. (Nuclear Research Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Part. Nucl. 5: No. 4, 359-384 (Apr 1975).

A review is presented of investigations of inelastic scattering of protons of energy higher than 10 MeV with excitation of low-lying collective levels of rare-earth nuclei. Theoretical analysis methods with allowance for the strong coupling of the channels, including approximate methods, are considered. Attention is called to new possibilities afforded by such an analysis, especially when polarized protons are used. The optical-potential parameters for the scattering of protons by spherical and deformed nuclei are given, as are the deformation parameters obtained in studies of electromagnetic processes and of the scattering of protons, deuterons, and α particles. (auth)

15919 A STUDY OF THE (n,α) REACTIONS INDUCED BY 18 MeV NEUTRONS IN ^{151}Eu, ^{153}Eu, ^{159}Tb, ^{165}Ho and ^{169}Tm. Glozwacka, L.; Jaskola, M.; Turkiewicz, J.; Zemlo, L. (Institute of Nuclear Research, Warsaw (Poland)); Kolowski, M.; Osakieicz, W. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). Nucl. Phys., A; 244: No. 1, 117-124(2 Jun 1975).

The energy spectra of α-particles emitted in the ^{151}Eu(n,α)^{148}Pm, ^{153}Eu(n,α)^{150}Pm, ^{159}Tb(n,α)^{156}Eu, ^{165}Ho(n,α)^{162}Tb and ^{169}Tm(n,α)^{166}Ho reactions have been measured at a neutron energy of 18.15 MeV. For the ^{165}Ho(n,α)^{162}Tb reaction the α-particle angular distribution has been measured as well. The results have been analyzed in terms of statistical, pre-equilibrium and knock-on models. (auth)

15920 ANOMALOUS SYSTEMATICS IN THE ODD-A TRANSITIONAL Os NUCLEI. Benson, D. Jr.; Kleinheinz, P.; Sheline, R. K. (Florida State Univ., Tallahassee). Contract AT(40-1)-2434. Nukleonika; 20: No. 2, 169-179(1975).

Levels are presented in the Nilsson formalism for the nuclei ^{189}Os and ^{191}Os studied by the (d,p), (d,t) and (n,γ) reactions and ^{193}Os studied by the (d,p) and (n,γ) reactions. Three types of anomalous systematics are described. The systematics of the Nilsson states 1/2[510] and 3/2[512] with increasing neutron

number remain extremely close to the ground state in contrast with expectations. This anomaly may be understood in terms of the Nilsson level diagram and decreasing deformation with increasing neutron number. Anomalous (d,p) and (d,t) cross sections are observed for the 3/2 and 5/2 members of the 1/2[510] and the 3/2[512] bands which can be semiquantitatively explained as a tendency on the part of the nucleus to restore the cross sections expected for a spherical nucleus. Finally there is an anomalously large transition probability for an E2 transition from a 5/2 state in both ^{189}Os and ^{191}Os which appears to be a rotational state built on the 9/2[505] configuration. This is strong evidence for triaxiality for the nuclei ^{189}Os and ^{191}Os. (7 figures) (auth)

15921 ENERGY CALCULATIONS FOR INTERACTING ROTATIONAL BANDS IN DEFORMED ODD AND ODD–ODD NUCLEI. Tamberg, Yu. Ya.; Balodis, M. K.; Milyuna, M. K.; Neiburg, L. A.; Plate, M. H.; Prokof'ev, P. T. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 1, 8-14(1975). (In Russian).

Energy levels of the interacting rotational bands have been calculated and mixing amplitudes have been found for nuclei ^{160}Tb, ^{176}Lu, ^{179}Hf, ^{182}Ta using the diagonalization of the unified model Hamiltonian energy matrices. The deviations of the theoretical energy values from the experimental ones have been found not to exceed 1 keV. The possibilities of applying the obtained results for the development of the level schemes containing interacting rotational bands are shown. (2 tables) (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 15082, 15458, 15795, 15811, 15838, 15845, 15891, 15903, 15920, 15967, 15970, 15985, and 15986.

15922 INCLUSIVE INELASTIC SCATTERING IN DISTORTED-WAVE BORN-APPROXIMATION–RANDOM-PHASE-APPROXIMATION THEORY. Tsai, S.F.; Bertsch, G.F. (Physics Department and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 11: No. 5, 1634-1637 (May 1975).

We calculate the double differential cross section for inelastic scattering of protons and α particles on ^{208}Pb and ^{90}Zr. We use the random-phase-approximation theory of the nucleus, and the distorted-wave Born-approximation theory of the excitation mechanism. In the continuum region, excitation energies 10–25 MeV, the experimental cross section exceeds the predicted by a factor of 2–4. We conclude that multistep reactions are important and in some cases dominate at these inelasticities. (auth)

15923 K-SHELL ELECTRON SHAKE-OFF ACCOMPANYING ALPHA DECAY. Rapaport, M.S.; Asaro, F.; Perlman, I. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 11: No. 5, 1740-1745 (May 1975).

The α spectra associated with *K*-shell electron shake-off in ^{210}Po and ^{238}Pu decay have been determined by *K* x-ray–α coincidence measurements. Although the shapes of the spectra generally agree with the theoretical expectations, some discrepancies are observed. The abundances per α particle of the total *K* electron shake-off effect were also determined in these measurements and found to be $(1.65 \pm 0.16) \times 10^{-6}$ for ^{210}Po and $(0.83 \pm 0.11) \times 10^{-6}$ for ^{238}Pu. These results are also compared with theoretical predictions, and further experimental and theoretical studies are suggested. (auth)

15924 *L*- AND *M*-SHELL ELECTRON SHAKE-OFF ACCOMPANYING ALPHA DECAY. Rapaport, M.S.; Asaro, F.; Perlman, I. (Nuclear Chemistry Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 11: No. 5, 1746-1754 (May 1975).

The L_I-, L_{II}-, L_{III}-, and *M*-shell vacancy distributions accompanying electron shake-off in the α decay of ^{210}Po have been measured by α-x-ray two parameter coincidence techniques. The ionization probabilities and the errors due to our measurements were $(5.11 \pm 0.40, 0.62 \pm 0.06,$ and $1.50 \pm 0.19) \times 10^{-4}$ for the L_I, L_{II}, and L_{III} subshells, respectively, and $(1.8 \pm 0.4) \times 10^{-2}$ the *M* shell. Possible errors in tabulated fluorescence and Coster-Kronig yields could increase the uncertainties to $(1.7, 0.5, 0.8) \times 10^{-4}$ and 0.6×10^{-2}, respectively. The energies and peak shapes of the α groups in coincidence with L_α, L_β, L_γ, and *M* x rays were also measured. The coincident groups were, respectively, 12.6 ± 1.4, 13.8 ± 1.4, 17.6 ± 2.1, and 3.1 ± 1.0 keV lower in energy than the ^{210}Po α_0 peak. Theoretical calculations by Hansen are in closer agreement with the experimental values for the *L* subshells than Migdal's theory, but discrepancies of about a factor of 2 still exist. (auth)

15925 POSSIBLE EVIDENCE FOR MICROSECOND SHAPE ISOMERISM IN Tl ISOTOPES. Uyttenhove, J.; Heyde, K.; Vincx, H.; Waroquier, M. (Ghent Rijksuniversiteit (Belgium)). Nucl. Phys., A; 241: No. 1, 135-143(31 Mar 1975).

The decay of isomeric states in ^{201m}Tl, ^{202m}Tl and ^{204m}Tl is investigated with a Ge(Li) detector. The isomeric states are produced with LINAC bremsstrahlung (24-32 MeV). Lifetimes and precise energies have been determined. In the ^{201m}Tl case, shape isomerism is proposed, based on calculations of the total potential energy surfaces and calculations of the lifetime in a Nilsson model. (auth)

15926 THE DECAY OF ^{192}Ir. Prasad, R.; Chaturvedi, L.; Chaturvedi, S. N.; Nigam, A. K. (Banaras Hindu Univ. (India). Dept. of Physics). Nucl. Phys., A; 243: No. 2, 317-325(19 May 1975).

The decay of ^{192}Ir has been studied with a Ge(Li) detector and a sum–coincidence spectrometer, used in conjunction with a slow–fast coincidence circuit. In ^{192}Os, a level at 1118 keV has been proposed, which is confirmed by the sum–coincidence spectrum at the 1118 keV gate. In ^{192}Pt, four previously unreported γ-rays of 177.6, 457.6, 594.0 and 1201 keV have been observed, and confirmed by the sum–coincidence spectrometer. (auth)

15927 THE INTERNAL COMPTON EFFECT IN ^{203}Tl. Smirnov, Yu. G.; Batkin, I. S.; Tchernigin, A. S.; Brudanin, V. B. (Voronezhskij Gosudarstvennyj Univ. (USSR)). Phys. Lett., A; 51: No. 7, 405-406(21 Apr 1975).

Spectra of photons emitting due to internal Compton effect in ^{203}Tl have been measured in a coincidence experiment. It is found that the calculated theoretical values from the formula of Wang Chang and Falkoff fit the experimental ones fairly well within the accuracy of the measurement. (auth)

15928 RESONANCE NEUTRON CAPTURE IN ^{198,199,201}Hg. Lone, M. A.; Earle, E. D.; Bartholomew, G. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Phys., A; 243: No. 3, 413-439(26 May 1975).

Partial radiation widths of γ rays of energies $E_\gamma > 4.1$ MeV following capture of neutrons with $E_n < 211$ eV have been measured in ^{199}Hg, ^{200}Hg and ^{202}Hg. Gamma-ray tables and decay schemes are given. Gamma-ray strength functions and level density distributions are derived. Departures from statistical behavior are observed in ^{199}Hg. It is found that the energy dependence of the level density below 3 MeV differs in functional form in the three isotopes. (auth)

15929 QUADRUPOLE CORE VIBRATIONS IN THE A = 211 ISOBARS. Ewart, G. M.; Gerace, W. J.; Walker, J. F. (Massachusetts Univ., Amherst (USA)). Nucl. Phys., A; 244: No. 1, 125-133(2 Jun 1975).

States of the A = 211 isobars are described as three particles coupled to each other and to a vibrating ^{208}Pb core. Model parameters are extracted from available data on A = 209, 210 isobars, but it is necessary to postulate a form for the two-body interaction to obtain all necessary matrix elements. Energy spectra and reduced transition probabilities are calculated and compared with experiment. (auth)

15930 ALPHA DECAY OF ^{210}At TO LEVELS IN ^{206}Bi. Jardine, L. J.; Shihab-Eldin, A. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 244: No. 1, 34-44(2 Jun 1975).

The α-decay of ^{210}At has been investigated with $\alpha-\gamma$ coincidence techniques. Spins of ^{206}Bi levels below 500 keV have been deduced from recent electron-capture studies of ^{206}Po, reaction studies of ^{206}Bi and present results. Calculations of the α-decay rates and electromagnetic transition probabilities using wave functions in a truncated configuration space are compared with the experimental results. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 15075, 15082, 15838, 15877, 15881, 15912, 15913, 15923, 15985, 16025, and 16040.

15931 (CEA-CONF-2970) EXPERIMENTAL STUDY OF THE FISSION DYNAMICS FOR THE ^{240}Pu NUCLEUS AT LOW EXCITATION ENERGY. Lachkar, J.; Patin, Y.; Sigaud, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1974. 8p. (CONF-7409106-5). Dep. NTIS (US Sales Only) $4.00.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

The energy dependence of some characteristics of fission have been studied for the fissioning nucleus ^{240}Pu. The variations of kinetic energies and fragment masses from ^{239}Pu (d,p f) have been measured as a function of the excitation energy of ^{240}Pu. These results have been analyzed together with those from studies of spontaneous fission and isomeric fission, as reported by other authors. The results tend to demonstrate the existence of two modes of fission, the first mode superfluid and the other viscous; these modes depend on the nature of the fissioning state. (3 figures) (auth)

15932 (GSI-tr-24/74) PRESENT CONCEPTION OF THE POSSIBILITY FOR THE NUCLEOSYNTHESIS OF SUPERHEAVY ELEMENTS IN NATURE. Berlovich, E. E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Nov 1974. 8p. (In German). INIS.

2 figs.; 23 refs. Published in Izv. Akad. Nauk SSR. Ser. Fiz. 38, 1786 (1974).

The question for the possibility of a nucleosynthesis superheavy nuclei on islands of higher stability at Z = 114 and 126 and N = 184 is discussed. This synthesis should be possible by rapid neutron capture in supernovae explosions (r-process). The synthesis of such nuclei on the surface of neutron stars by β-transitions is discussed, and the question for the time of nucleosynthesis of heavy nuclei in milky way systems. (GE)

15933 (NP-20343, pp 85-90) DETERMINATION OF THE CHARGE DISTRIBUTION IN THE 132 CHAIN BY THE FISSION OF PLUTONIUM-239 WITH THERMAL NEUTRONS. Paffrath, G. 15 Jun 1974. (In German).

In annual report, 1973.

15934 (NP-20343, pp 95-103) RADIOCHEMICAL YIELD DETERMINATION OF VARIOUS REACTION PRODUCTS IN THE BOMBARDMENT OF URANIUM-238 WITH ARGON-40 AND KRYPTON-84 IONS. Kratz, J. V. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Liljenzin, J. O.; Norris, A. E.; Binder, L.; Seaborg, G. T. 15 Jun 1974. (In German).

In annual report, 1973.

15935 TWO-DIMENSIONAL DESCRIPTION OF THE VIBRATIONAL MOTION IN ACTINIDE NUCLEI. Dudek, W. (Univ., Warsaw). Acta Phys. Pol., Ser.; B6: No. 2, 295-308(1975).

Stiffness and mass parameters as well as the energies of the vibrational states in some actinide nuclei were calculated. Only quadrupole and hexadecapole degrees of freedom were included. The calculations were performed in the vicinity of the first minimum of the energy surface, by making use of three different approaches: Mottelson-Nilsson-Bés-Szymański, Strutinsky and microscopic ones. The results obtained in the calculations were compared. (auth)

15936 ^{241}Am NEUTRON RESONANCE PARAMETERS IN THE 8 TO 30 eV ENERGY RANGE. Belanova, T. S.; Kolesov, A. G.; Nikolaev, V. M.; Safonov, B. A.; Gabeskiriya, V. Ya.; Poruchikov, V. A.; Kalebin, S. M.; Ivanov, R. I.; Gudkov, O. M. At. Energ. (USSR); 38: No. 1, 29-34(Jan 1975). (In Russian).

Neutron resonance parameters in the energy range from 8 to 30 eV and the energy dependence of the total neutron cross section from 8 to 150 eV were obtained for the isotope ^{241}Am. The measurements were performed on the reactor SM-2 by the time-of-flight method. A neutron burst was formed by a selector with three synchronous rotors suspended in a magnetic field. A set of He counters was used as a neutron detector. The spectrometer resolution was 70 ns/m. AmO_2 powder of high purity was used—the 99.9 ± 0.2 mg target consisted of 99.99% ^{241}Am. The measurements were carried out for two specimen thicknesses, 0.63×10^{21} at/cm^2 and 0.33×10^{22} at/cm^2. The resonance parameters in the above energy range were calculated by the shape and area method for 27 levels, five of which (10.11, 11.58, 12.06, 14.32, and 20.28 eV) were determined for the first time. The present measurements did not confirm the presence of high levels with energies of 8.28 and 18.37 eV for ^{241}Am. The cross section for potential neutron scattering by ^{241}Am nuclei was obtained (σ_p = 12.8 ± 1 barn). The mean distance between levels $\langle D \rangle$ = 0.70 ± 0.10 eV and the neutron strength function $S_0 = (0.75 \pm 0.23) \cdot 10^{-4}$ were calculated. Experimental distributions for reduced neutron widths and intervals between levels are compared with theoretical values. (4 figures, 2 tables) (auth)

15937 FISSION CROSS SECTION OF ^{235}U FROM 3 TO 20 MeV. Czirr, J. B.; Sidhu, G. S. (Univ. of California, Livermore). Nucl. Sci. Eng.; 57: No. 1, 18-27(May 1975).

The relative energy dependence of the ^{235}U fission cross section has been measured with respect to the (n,p) scattering reaction for neutron energies from 3 to 20 MeV. The Lawrence Livermore Laboratory Linac provided a pulsed source of neutrons and energies were measured by neutron time of flight. The flux monitor consisted of an annular polyethylene proton radiator with a shielded recoil detector. The total error in the relative ^{235}U(n,f) cross section is +-1 percent from 3 to 7 MeV, +-2 percent at 14 MeV, and +-6 percent at 20 MeV. (9 figures, 3 tables) (auth)

15938 E2/M1 MIXING RATIO FOR THE TRANSITION 43.4 keV IN ^{237}Np. Vasileva, N. Ts. (Univ., Sofia). Bulg. J. Phys.; 1: No. 2, 161-164(1974). (In Russian).

The directional correlation of the 164.7-(43.4)-59.6 keV gamma cascade in the decay of ^{241}Am → ^{237}Np was investigated. The measurements were performed with two NaJ (Tl) scintillation counters and a fast-slow coincidence circuit with resolving time $2\tau_0 = 2.4 \times 10^{-9}$ s. Because the half-life of the 59.6 keV excited state is 6×10^{-9} s, the correlation function measured should be attenuated due to extranuclear fields. For the calculation of an unperturbed angular correlation the time spectra of fast coincidences were taken with a time-to-pulse-height converter. On the basis experiment the following results are obtained: the mixing ratio δ^2(43.4 keV) = 0.07 to 0.49; g_R and g_K nuclear factors of the 59.6-keV excited state. (auth)

15939 PRODUCTION OF ^{245}Bk AND STUDY OF ITS α DECAY. Baronov, S. A.; Shatinskii, V. M.; Chistyakov, L. B.; Shuboko, V. M. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 21: No. 1, 230-231(Jan 1975). (In Russian).

The element ^{245}Bk was obtained by irradiation of enriched ^{243}Am with He nuclei in accordance with an (α,2n) reaction. The α spectrum of ^{245}Bk ($T_{\frac{1}{2}}$ = 4.98 days) was studied in the energy interval ΔE_α = 6400 to 5800 keV. The α energies, their intensity, coefficient of forbiddenness, and the energy levels of the daughter nucleus are tabulated. A scheme for the energy levels of ^{241}Am was constructed in which three bands with their quantum characteristics was constructed. (JSR)

15940 MASS DISTRIBUTIONS FOR THERMAL-NEUTRON-INDUCED FISSION OF ^{255}Fm AND ^{251}Cf. Flynn, K.F.; Gindler, J.E.; Sjoblom, R.K.; Glendenin, L.E. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 11: No. 5, 1676-1680 (May 1975).

Mass distributions for thermal-neutron-induced fission (n,f) of ^{255}Fm and ^{251}Cf have been determined radiochemically. Both mass distributions are asymmetric with a peak-to-valley ratio of about 2.6 for ^{255}Fm and about 13 for ^{251}Cf. Cross sections were determined to be 3200 ± 320 b for ^{255}Fm(n,f) and 5300 ± 530 b for ^{251}Cf(n,f). (auth)

15941 EXPERIMENTAL STUDY OF DYNAMICAL EFFECTS IN THE FISSION OF ^{240}Pu AT LOW ENERGY. Lachkar, J.; Patin, Y.; Sigaud, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). J. Phys. (Paris), Lett.; 36: No. 4, L.79-L.83(Apr 1975). (In French).

The variations of kinetic and excitation energies and fragment masses from the (d,pf) and (n,f) reactions were studied as a function of the excitation energy of ^{240}Pu. These results were analyzed together with those from spontaneous and isomeric fission reported elsewhere. They tend to illustrate the existence of two modes of fission; the first one is superfluid, the other is strongly damped in the last stage of the fission process. (auth)

Nuclear Theory

Refer also to abstracts 13721, 15084, 15441, 15650, 15689, 15785, 15817, and 15886.

15942 (AE-503) SYSTEMATIC STUDY OF NEUTRON INELASTIC SCATTERING IN THE ENERGY RANGE 2.0 TO 4.5 MeV. Almen-Ramstroem, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Apr 1975. 109p. Dep. NTIS (US Sales Only) $8.50.

Fast neutron inelastic scattering from eighteen elements covering the atomic mass region 27 to 209 has been measured with time-of-flight technique for incident neutrons in the energy range 2.0 to 4.5 MeV. Excitation functions for the population of the individual levels in the nuclei have been derived. The inelastic scattering cross sections have been determined relative to those of the H(n,n)H reaction. Corrections have been applied for the effects of the anisotropic intensity distribution of the neutron source, the attenuation of the neutron flux in the sample as well as the multiple scattering of the neutrons. The scattering process has been described using the Hauser-Feshbach-Moldauer model with a local optical potential with the inclusion of a spin-orbit interaction term. The inelastic scattering cross sections calculated with the model describe in most cases the experimental data well within 20 per cent. In addition, comparisons made between calculated and experimental excitation functions have made it possible to determine spins and parities of some levels, for which these quan-

tities previously have been unknown or uncertain. (50 figures, 28 tables, 113 references) (auth)

15943 (GSI-J-2-74, pp 217-227) REPORT OF THE WORKS SUPPORTED BY THE GSI DURING THE TIME OF JULY 1973 TO JUNE 1974. Nov 1974. (In German).
30 refs.
In preparation of experiments with the GSI heavy-ion linear accelerator. Annual report from the University groups 1973/1974. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik).
The following works were supported: questions for the mass distribution of fission fragments in the theoretical nuclear fission; the theory of heavy ion scattering with sub-Coulomb-resonances and fragmentation; quantum electrodynamics of strong fields in heavy ion collisions, induced and spontaneous pair production, and nuclear structure theory and giant resonances. (GE)

15944 (ITP-74-105P) EXCITATION OF NUCLEAR COLLECTIVE STATES UNDER THE ELECTRON INELASTIC SCATTERING. Tartakovskii, V. K.; Gomshi, A. K.; Ezhov, S. N. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.
The cross-sections of fast electron inelastic scattering by the deformed and spherical light even-even nuclei, accompanied by the excitation of low-lying collective levels of nuclei, are calculated. The rigid and deformed non-spherical nuclei are considered. It is shown that in using the realistic charge distribution density in the nucleus the consideration of the softness of nuclei betters the agreement with experiment of the calculated inelastic and elastic electron form factors of some nuclei having deformations in the ground states. Taking into account the softness of nuclei one manages to obtain such an agreement for the same structure parameters simultaneously with the data on the electron inelastic and elastic scattering. It is shown that the cross-sections of electroexcitation of the spherical nuclei collective states are sensitive to transverse vibrations in the nuclei. (6 figures) (auth)

15945 (KIYI-74-13) ROTATIONAL BANDS OF DEFORMED NUCLEI AS THE INFINITE DIMENSIONAL REPRESENTATIONS OF NONCOMPACT GROUPS. Malyuta, Yu. M. (AN Ukrainskoj SSR, Kiev, Inst. Yadernykh Issledovanij). 1974. 19p. (In Russian). INIS.
The application of the theory of noncompact groups in nuclear spectroscopy is studied. By the method of indexed concepts a degenerate series of representations of the group SL (3,R) is constructed. The results are applied to describing E2-transitions in even-even, deformed nuclei. (SJR)

15946 (LBL-3675) 2ND HIGH ENERGY HEAVY ION SUMMER STUDY, JULY 15-26, 1974, LAWRENCE BERKELEY LABORATORY. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1974. 382p. (CONF-740740-). Dep. NTIS $10.60.
A collection of 9 papers concerning the role of high energy heavy ions in various areas of physics is presented. Five additional papers were previously cited in NSA as 30:08410 and 31:05008, 18542, 27737, and 31568. (SDF)

For abstracts of individual papers see: 15084, 15085, 15104, and 15947-15952.

15947 (LBL-3675, pp 73-107) FIELD THEORY METHODS FOR FINITE NUCLEAR SYSTEMS AND THE POSSIBILITY OF DENSITY ISOMERISM. Kerman, A. K.; Miller, L. D. (Massachusetts Inst. of Tech., Cambridge). 1974.
In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).
A derivation of the relativistic Hartree equations for infinite or finite systems is presented. The Hartree approximation of the sigma model field theory is then solved exactly for the case of infinite nuclear matter and the results are compared to the approximate results of Lee and Wick. The equations appropriate for an iterative solution of the Hartree approximation of a finite system are also discussed. It is concluded that the sigma model is a poor candidate for predicting the behavior of nuclear matter at densities greater than those found in normal nuclei. (6 figures) (SDF)

15948 (LBL-3675, pp 109-175) CHARGED VACUUM IN OVERCRITICAL FIELDS AND ITS TEST IN H.I. COLLISIONS. Mueller, B.; Smith, R. K.; Greiner, W. (Johann Wolfgang Goethe Univ., Frankfurt am Main). 1974.
In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).
The problem of bound states buried in the continuum is discussed in terms of Dirac theory and is applied to the autoionization of positrons. Formal aspects of the change in negative energy continuum in overcritical Coulomb fields are developed. Effects of vacuum polarization and nonlinearities in the electromagnetic and spinor fields are discussed. Experimental studies with heavy ions producing intermediate molecules are described followed by a discussion of analysis of x-rays from these states. Finally, induced decay of the vacuum in overcritical fields is considered. (24 figures, 51 references) (SDF)

15949 (LBL-3675, pp 177-195) SOME ASPECTS OF NUCLEAR ION-ION POTENTIALS. Moszkowski, S. A. (Univ. of California, Los Angeles). 1974.
In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).
The nuclear aspects of ion-ion interactions at low and high energies are discussed. Specific models, including Glauber theory, the droplet model, and the black sphere model, are briefly considered. It is concluded that high energy heavy ion-ion scattering experiments may shed light on the behavior of high density nuclear matter and possibly also on high energy behavior of effective nucleon-nucleon interactions, and of nuclear transparencies. (6 figures) (SDF)

15950 (LBL-3675, pp 261-274) CAN ONE SEE N*'s IN NUCLEI. Schaeffer, R. (CEN, Saclay, France). 1974.
In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).
The possibility that the (p,d) pickup reaction proceeds partly by the pickup of a baryon resonance in the target is considered, and a calculation of the deuteron vertex for various N*'s is presented. In this context, the $^{12}C(p,d)^{11}C$ reaction is examined. Heavy ion reactions as a method of searching for N* transfers are discussed. Finally, other reactions are suggested that might yield information on baryon resonances. (4 figures) (SDF)

15951 (LBL-3675, pp 283-292) FRAGMENTATION OF HEAVY NUCLEI AT HIGH ENERGY. Lepore, J. V.; Riddell, R. J. Jr. (Univ. of California, Berkeley). 1974.
In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).
Fragmentation of high-energy nuclei is treated using the quantum mechanical sudden approximation. Nuclear wave functions necessary for the method are constructed using the shell model. Momentum distributions for ^4He particles from ^{16}O and ^{12}C and for protons coming from ^{12}C are determined. They are dominated by a Gaussian factor whose standard deviation is simply related to the shell model parameters of projectile and fragment. (1 figure) (auth)

15952 (LBL-3675, pp 293-306) PHENOMENOLOGICAL APPROACH TO NUCLEAR FRAGMENTATION. Uchiyama, F. (Univ. of California, Berkeley). 1974.
In 2nd high energy heavy ion summer study. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).
The nova model of hadron-hadron scattering is extended to treat the fragmentation of heavy nuclei, and the results are in agreement with recent experiments. (4 figures, 1 table) (auth)

15953 (SUNI-37, pp 6-8) ANGULAR CORRELATION OF NEUTRONS FROM ^{252}Cf SPONTANEOUS FISSION. Pringle, J. S.; Brooks, F. D. 1974.
In annual research report, 1974. Southern Universities Nuclear Inst., Faure (South Africa).

15954 NUCLEAR HEXADECAPOLE ANTISHIELDING FACTORS. Sen, K. D.; Narasimhan, P. T. (Indian Inst. of Technology, Kanpur). Phys. Rev., A.; 11: No. 4, 1162-1167(Apr 1975).
Using Hartree-Fock-Slater wave functions, values of the nuclear hexadecapole antishielding factor eta/sub infinity/ were calculated for the following ions: Ti^{3+}, Mn^{2+}, Cu^{+}, Zn^{2+}, Ge^{4+}, Rb^{+}, Zr^{3+}, Nb^{5+}, Tc^{2+}, Ag^{+}, In^{3+}, Sb^{3+}, Cs^{+}, Hf^{3+}; Re^{2+}, Au^{+}, Hg^{2+}, Bi^{3+}, Fr^{+}, Th^{3+}, and Am^{2+}. The radial distortions induced in the core electrons due to nuclear hexadecapole moment were calculated using Sternheimer's perturbation numerical procedure. The contribution to eta/sub infinity/ due to the nf shell is much weaker in magnitude than that from the nd shell. In the three nd series of ions considered, maximum values of eta/sub infinity/ are obtained in the cases of Cu^{+}, Ag^{+}, and Au^{+} ions, respectively, where the outer d shell is complete and is most external. With the assumption that a large nuclear quadrupole moment may be associated with a significant hexadecapole moment, it is suggested that of the systems examined here containing nuclei with spin I greater than or equal to 2, Bi^{3+}, Re^{2+}, Sb^{3+}, In^{3+}, and Mn^{2+} are likely to exhibit prominently nuclear hexadecapole interaction effects since these have favorable natural abundance, quadrupole moment, magnetic resonance sensitivity, and large eta/sub infinity/ values. (auth)

15955 SOME FEATURES OF COMPOUND NUCLEUS FORMATION AND DECAY IN REACTIONS INDUCED BY HEAVY IONS

WITH ENERGIES HIGHER THAN 10-MeV/NUCLEON. Oganesian, Yu. Ts.; Penionzhkevich, Yu. E.; Shamsutdinov, A. O. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., Ser.; B6: No. 2, 323-332(1975).

Reactions involving the formation and decay of compound nuclei with excitation energies up to 140 MeV were studied. It was shown that the cross section for compound nucleus formation was about 20% of the total one. The decrease in the cross section is discussed in terms of the effect of the angular momentum on the reaction mechanism. The excitation functions of reactions with 3 to 12 neutrons evaporated from the compound nucleus are compared with the predictions of the statistical model. The mass and isotope distributions of the fission products in reactions of uranium with carbon ions of different energies were measured. The results obtained are discussed from the point of view of the reaction mechanism and possibilities of synthesizing isotopes. (auth)

15956 IS TUNNELLING NECESSARY FOR α-DECAY? Basu, M. K. (Univ. College of Science, Calcutta). Sci. Cult.; 40: No. 11, 471-472(Nov 1974).

Gamow's classic "one-body" model of α decay suffers from a serious inadequacy of the fundamental basis — the postulate of preexistent α particles inside the α emitter prior to emission. This paper attempts to present a clear picture of how an α cluster inside the α emitter is formed into and emitted as an α particle. The theoretical discussion yields expressions for the α decay radius and the α formation probability. Values of the latter range from 0.08 to 0.175. Values of the former lie in the range of 9.4 to 11.2 fm, consistent with the true definition. (2 figures) (RWR)

15957 APPLICATION OF DENSITY-DEPENDENT FORCES TO THE CALCULATION OF NUCLEAR STRUCTURE. I. Nemeth, J. (Lorant Eotvos Univ., Budapest). Fiz. Szemle; 24: No. 5, 144-150(May 1974). (In Hungarian).

The theoretical bases of derivation of density-dependent nuclear forces were investigated, in order to use them for the determination of the energy and density distribution in the nuclei. This required the development of a convergent approximation method. For the case of simplicity, the study was based on nuclear matter - a fictive infinite system consisting of identical number of neutrons and protons, excluding the Coulomb interaction. The equations derived for forbidden-shell nuclei were found to be complex; however, in the case of the doubly-forbidden shells ^{16}O, ^{40}Ca, ^{48}Ca, ^{90}Zr and ^{208}Pb the equations became considerably simplified. Results for these nuclei were tabulated, finding a good agreement between theory and experimental results. (TTT) (2 tables, 3 figures)

15958 PERSPECTIVES AND TRENDS IN NUCLEAR PHYSICS RESEARCH. Berenyi, D. (Nuclear Research Inst., Debrecen, Hungary). Fiz. Szemle; 24: No. 5, 129-134(May 1974). (In Hungarian).

Several conferences were held during the last few years in the Soviet Union, the United States and elsewhere on the future outlook for physics and nuclear physics in particular. The concepts developed by Weisskopf and Weinberg are examined. Nuclear physics reached an advanced stage; its results may be applied to solve problems of nuclear structure and even to test industrial materials. However, it is still primarily a basic science, aimed at solving nature's secrets. The following are considered the most promising areas for future research: heavy-ion reactions, study of nuclei far from the stability line, high-energy (up to several GeV) accelerators, fundamental nuclear interactions, higher nuclear levels and low-probability transitions. Nuclear physics is already widely applied in other fields of science, such as solid-state physics, astrophysics and even for the engineering control of industrial processes. This trend is recognized in Hungary and the Academy of Sciences support the use of nuclear techniques (neutron scattering, Mossbauer spectroscopy, etc.) in solid-state research and the application of accelerator-prepared short-lived radioisotopes in medicine. It is proposed to build an intermediate-size cyclotron in the country to create a basis for further developments. (TTT) (5 figures)

15959 COULOMB ENERGY ANOMALY AND CHARGE ASYMMETRY. Negele, J. W. (Massachusetts Inst. of Tech., Cambridge). Comments Nucl. Particle Phys.; 6: No. 1, 15-24 (Feb 1974).

The so-called "Coulomb energy anomaly" concept arose from a systematic study by Nolen and Schiffer of mirror nucleus energy differences and isobaric analog state displacement energies throughout the periodic table. The former were interpreted as the Coulomb energy of the excess nucleon in the field of the core protons, which was known from electron scattering, with corrections for exchange, the nucleon form factor, and the electromagnetic spin-orbit potential. The latter were interpreted as the Coulomb energy of a proton with the same spatial distribution as the excess neutrons in the target nucleus interacting with the Coulomb field of the core protons, again including similar corrections. The neutron excess radii required to fit the observed energies were found to be systematically substantially smaller than could be explained by any reasonable models. One of the complications of the nuclear many-body problem is the simultaneous uncertainty of the nature of the nucleon–nucleon interaction and the structure of the nuclear wave function. Coulomb effects in nuclei in principle offer the possibility of separating the interaction from the wave function and thus extracting specific information regarding the nuclear wave function. It is concluded that charge asymmetry is the only reasonable mechanism to explain the Coulomb energy anomaly. Opportunities for theoretical and experimental work are indicated. On the theoretical side it would be useful to make an analysis of all processes to which charge asymmetry could contribute. 19 references. (UK)

15960 SLOW-NEUTRON MULTIPLE SCATTERING. Sears, V. F. (Atomic Energy of Canada, Ltd., Chalk River). Advan. Phys.; 24: No. 1, 1-45(Jan 1975).

Slow-neutron scattering is perhaps the most powerful method presently available for investigating the structure and dynamics of materials on the atomic level. A review and extension of the theoretical basis for multiple scattering corrections from the point of view of the Vineyard theory is presented. The theory is formulated for a sample of arbitrary size and shape and a general expression is obtained for the effective scattering function as an expansion in terms of orders of scattering (single, double, etc.). The general properties of this expansion are investigated with particular emphasis on the question of convergence and on ways of improving the rate of convergence by, e.g., the use of absorbing spacers. Exact results are obtained for the multiple scattering in an infinite plane slab. An approximate, semianalytic theory of multiple scattering is developed as an alternative to the Monte Carlo approach. The theory is applied to plane slab, spherical and cylindrical geometries. Finally, a detailed discussion is given of the multiple-scattering correction for recent experiments on liquid neon. (auth)

15961 PRIMORDIAL NUCLEAR MATTER AND NUCLEOSYNTHESIS. Trivedi, B. M. P. (Inst. of Science, Bombay). Curr. Sci. (India); 44: No. 10, 343(20 May 1975).

It is shown that the neutron is a better choice than hydrogen for the starting material for primordial matter. (JFP)

15962 VOLUME INTEGRALS OF THE ABSORPTIVE PART OF THE PROTON OPTICAL POTENTIALS. Agrawal, D.C.; Sood, P.C. (Nuclear Physics Section, Physics Department, Banaras Hindu University, Varanasi 221005, India). Phys. Rev. C 11: No. 5, 1854-1858 (May 1975).

The volume integrals of the absorptive part of proton optical potentials are evaluated for various combinations of the form (surface and/or volume), depth, and geometry of the absorptive potential which have been found to give comparable fits to the data for different targets at a particular energy, and also at different energies. It is concluded that the total (sum of the surface and volume absorptions) volume integral per particle of the absorptive part of the proton optical potential is a well-defined quantity in that it is practically independent of (a) the form (surface and/or volume absorption) and the geometrical parameters employed, (b) the mass number of the target nucleus at each energy, and (c) the incident proton energy in the range 10–60 MeV. Examination of the presently available results yields a value 115 ± 15 MeV fm^3 for this quantity. The energy independence of these volume integrals is in contrast with the marked energy dependence observed for the volume integrals of the real part of the optical potentials. (auth)

15963 EXACT CALCULATION OF PENETRABILITY THROUGH TWO-PEAKED FISSION BARRIERS. Sharma, R.C. (Department of Physics, Concordia University, Montreal, Canada H3G1M8); Leboeuf, J.N. Phys. Rev. C 11: No. 5, 1849-1850 (May 1975).

Penetrability is computed for a double-hump potential barrier of Strutinsky type, where both incident and reflected waves in the first well are taken into consideration to include the pre-fission state of a nucleus. Results are discussed and comparison is made with the work of Cramer and Nix. (auth)

15964 MAGNETIC SUSCEPTIBILITY OF NEUTRON MATTER. Haensel, P. (Institute of Theoretical Physics, Warsaw University, Warsaw, Poland). Phys. Rev. C 11: No. 5, 1822-1827 (May 1975).

The magnetic susceptibility of neutron matter is calculated in Brueckner theory with the Reid hard-core potential and the Mongan nonlocal separable potential. The rearrangement contribution, calculated with suitable approximations, turns out to be important at the densities above normal nuclear density. The results obtained for the Reid hard-core potential are similar to those obtained previously for the Reid soft-core potential. No evidence of a transition to ferromagnetic state is found. (auth)

15965 CHARGE SYMMETRY OF THE NUCLEAR FORCE AS OFF-SHELL CONSTRAINT. Sauer, P.U. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. C 11: No. 5, 1786-1802 (May 1975).

Off-shell changes are generated in the $^1S_0$ nucleon-nucleon interaction using the Reid soft-core potential and unitary transformations of short range. Charge symmetry is assumed for the nuclear force. The same off-shell variations of the Reid potential are employed as the hadronic part of the proton-proton interaction and as neutron-neutron interaction. The Reid potential fits the experimental proton-proton data. It also accounts for the neutron-neutron scattering length with satisfying accuracy. The off-shell behavior of the Reid potential is varied in two different ways. First, off-shell changes are performed which preserve the fit to the proton-proton data. Most transformed potentials of the type attempted here are unable to yield the correct experimental value of the neutron-neutron scattering length and have to be rejected. A simple practical rule is given according to which the off-shell changes consistent with the neutron-neutron scattering length can be selected. Second, off-shell changes are performed which leave the neutron-neutron scattering length unaltered. Transformed potentials of this type have usually been employed in nuclear-structure calculations. The potentials which exhibit large off-shell effects in nuclear structure are unable to account for the experimental proton-proton data. Their off-shell effects are therefore of no physical significance, and the potentials have to be rejected. A simple practical rule is given according to which the off-shell changes consistent with the experimental proton-proton data can be selected. (auth)

15966 GAMMA-DECAY DATA FROM PARTICLE-γ CORRELATION FUNCTIONS AT FIXED γ ANGLES. Eyrich, W.; Schneider, S.; Hofmann, A.; Vogler, F. (Physikalisches Institut der Universität Erlangen-Nürnberg, 8520 Erlangen, Germany). Phys. Rev. C 11: No. 5, 1658-1663 (May 1975).

Data for γ transitions extracted from particle-γ angular correlation functions, which are measured as a function of the particle angle, are shown to be of similar quality as the data extracted by methods in which the γ angle is varied. The data extracted in this way are believed to complete usefully the data obtained by the conventional methods. As an example the reaction $^{52}Cr(d,p\gamma)^{53}Cr$ is studied. The correlation functions are calculated with the distorted-wave Born approximation. The extracted mixing ratios are found to be nearly independent of the parameters of the optical potential. (auth)

15967 QUASIELASTIC PION SCATTERING IN THE (3,3) RESONANCE REGION. Silbar, R.R. (Swiss Institute for Nuclear Research, 5234 Villigen, Switzerland).
Phys. Rev. C 11: No. 5, 1610-1621 (May 1975).

After qualitative discussion of what can be expected in quasielastic (π,π') experiments, a semiclassical model is developed. The mean free path for pion absorption in nuclear matter is a more or less unknown ingredient of the model, but the predictions for the effective nucleon number are insensitive to it. The uncertainties of nuclear corrections can be largely avoided by considering ratios of quasielastic cross sections between different nuclei. (auth)

15968 COVARIANT PION-NUCLEUS OPTICAL POTENTIAL. Celenza, L.; Liu, L.C.; Shakin, C.M. (Department of Physics and Institute of Nuclear Theory, Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. C 11: No. 5, 1593-1609 (May 1975).

We present a detailed evaluation of the leading term (triangle diagram) of the pion-nucleus optical potential. The development uses a covariant multiple scattering theory introduced previously. It is shown how recent phenomenological studies of the pion-nucleon (off-shell) scattering amplitudes may be incorporated into this theory. Further, various problems associated with the transformation of the pion-nucleon scattering amplitudes from the center of mass of the π-N system to the center of mass of the π-*nucleus* system are resolved in this approach. (auth)

15969 NUCLEUS-NUCLEUS OPTICAL POTENTIAL. Sinha, B. (Wheatstone Laboratory, King's College, London WC2R 2LS, United Kingdom). Phys. Rev. C 11: No. 5, 1546-1556 (May 1975).

The real part of the nucleus-nucleus potential is calculated by using a density-dependent effective interaction where the local density takes into account the contribution of both the projectile and the target densities. The results indicate that the repulsion produced by the density-dependent part of the interaction is important when the densities of the two nuclei overlap significantly but not so important at a distance much greater than the touching radius. For a quite heavy target-projectile system the repulsive term is important even in the tail region. The exchange effects have been found to be not so important. The imaginary potential is approximately estimated by using a forward scattering amplitude approximation. The preliminary results agree with phenomenological predictions. The parameter r_C, which determines the critical distance of approach both for the real and the imaginary potential, remains constant [$r_{C0} \simeq 1.0 = R_{C0}/(A_T^{1/3} + A_T^{1/3})$] throughout the Periodic Table. (auth)

15970 USE OF GLAUBER APPROXIMATION AT LOW ENERGIES. Brissaud, I.; Bimbot, L.; Le Bornec, Y.; Tatischeff, B.; Willis, N. (Institut de Physique Nucléaire, B.P. No. 1, 91406 - Orsay, France). Phys. Rev. C 11: No. 5, 1537-1545 (May 1975).

To describe elastic and inelastic scattering, Glauber theory has been used often at an energy higher than 1 GeV with considerable success. It is also interesting to apply this model to scattering at lower energies to define its limits of validity. Cross sections and polarization values for proton scattering are calculated at 75, 155, 315, and 1040 MeV. The results for optical potentials in an exact solution or in the eikonal approximation are compared. First-order corrections due to Wallace are also included. These improve the fit at small momentum transfers. (auth)

15971 SECOND BORN APPROXIMATION FOR MAGNETIC MULTIPOLE ELECTROEXCITATION. Bergstrom, J.C. (Saskatchewan Accelerator Laboratory, University of Saskatchewan, Saskatoon, Canada, S7N 0W0). Phys. Rev. C 11: No. 5, 1514-1524 (May 1975).

The problem of the Coulomb corrections to inelastic electron scattering cross sections is treated in the distorted wave Born approximation (DWBA) using electron wave functions evaluated in the second Born approximation. The formalism is developed for magnetic multipole transitions in a manner analogous to the method developed by Cutler for Coulomb transitions, in which the nuclear and electron physics are represented by separate factors in the integrand of a double integral expression for the cross section. Since the nuclear factor turns out to be simply the inelastic form factor in the first Born approximation, the usual problem of having to specify the transition current density is avoided. The Coulomb correction is considered in detail for $M1$ transitions, and numerical comparison with "exact" DWBA results is presented. (auth)

15972 EFFECT OF THE DEUTERON D STATE ON DISTORTED-WAVE IMPULSE-APPROXIMATION CALCULATIONS OF (p,π) REACTIONS. Fearing, H.W. (Nuclear Research Centre, Department of Physics, University of Alberta, Edmonton, Alberta, Canada). Phys. Rev. C 11: No. 5, 1493-1496 (May 1975).

We explore the effects of including the D-state part of the deuteron wave function in a previous distorted-wave impulse-approximation calculation applied to the reaction $pd \rightarrow t\pi$ in the resonance region. We find that the D-state component tends to increase the cross section at large angles by amounts ranging from 15% at 470 MeV to a factor of 3 at 1050 MeV. Results are, however, sensitive to the short-range details of both S and D parts of the deuteron wave function. (auth)

15973 CORRECTIONS TO EIKONAL MODELS FOR HADRON-NUCLEUS SCATTERING AT HIGH AND INTERMEDIATE ENERGIES. Gillespie, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires); Gustafsson, C. (Neuchatel Univ. (Switzerland). Inst. de Physique); Lombard, R. J. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 242: No. 3, 481-492(5 May 1975).

Corrections to eikonal amplitudes for hadron-nucleus scattering are calculated for realistic optical potentials at medium and high energies. The corrections, involving only one-dimensional integrals, are found to provide rapid convergence towards the exact results. In contrast to the lowest-order eikonal approximation, the corrections lead to a sensitivity of the calculated cross section to the sign of the real part of the optical potential. (auth)

15974 THE THREE-BODY FORCE, OFF-SHELL πN SCATTERING AND BINDING ENERGIES IN NUCLEAR MATTER. Coon, S. A.; Scadron, M. D.; Barrett, B. R. (Arizona Univ., Tucson (USA). Dept. of Physics). Nucl. Phys., A; 242: No. 3, 467-480 (5 May 1975).

The off-shell πN amplitude occurring in the two-pion exchange three-body force is re-examined subject to all of the constraints of current algebra. This amplitude is not dominated by the $\Delta(1231)$ isobar; instead, if the σ-term is known, it can be determined from on-shell scattering. The resulting contribution to the binding energy of nuclear matter is small but attractive, varying from 0.2 MeV to 1.5 MeV, corresponding to πN σ-terms of 70 MeV to 40 MeV. (auth)

15975 AN OBE MODEL FOR THE TWO-NUCLEON PROBLEM BASED ON NON-COVARIANT PERTURBATION THEORY. Kotthoff, K.; Holinde, K.; Machleidt, R.; Schuette, D. (Bonn Univ. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., A; 242: No. 3, 429-444(5 May 1975).

The NN scattering data and the deuteron properties are calculated within an OBE scheme based upon the treatment of a field theoretical Hamiltonian within old fashioned perturbation theory. The structure of the relevant equations is discussed in detail. The results show that one arrives at a consistent description of NN data—as consistent as with any other OBE model—so that the application of the same scheme to the calculation of meson current corrections to nuclear matter properties should be justified. (auth)

15976 DESCRIPTION OF EXCITED STATES IN SYSTEMS WITH SHORT-RANGE CORRELATIONS. da Providencia, J. (Coimbra Univ. (Portugal)); Shakin, C. M. (Brooklyn Coll., N. Y. (USA)). Nucl. Phys., A; 242: No. 3, 376-388(5 May 1975).

It is shown that the cluster expansion formalism previously developed as a basis for a theory of the ground state of correlated systems may be generalized in such a way as to also provide a basis for the description of excited states of closed or open-shell systems. In particular, the possibility of using the cluster expansion formalism in combination with the generator coordinate method is discussed. (auth)

15977 LONG-RANGE JASTROW CORRELATIONS. Krotscheck, E.; Ristig, M. L. (Koeln Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 242: No. 3, 389-405 (5 May 1975).

A promising many-body method to evaluate the equation of state for dense neutron matter and liquid helium is developed. The ground-state of the Fermi fluid is described by a conventional Jastrow ansatz. The presence of short- and long-range correlations is admitted. Under this assumption the generating function which has been introduced by Wu and Feenberg is studied. A graphic formulation is employed and the diagrammatic expansion of the generating function and the radial distribution function developed. If long-range correlations are assumed, the diagrams have singular parts. A proof is given that the total contribution of such diagrams to the generating function which contain two, three, and four correlation lines is of finite value. The same property is shown for a selected class of singular diagrams containing α correlation lines ($\alpha > 4$). To verify the cancellation phenomenon, a two-body function which serves graphically as an insertion into selected singular diagrams is introduced. For the remaining classes of diagrams three, four, ..., n-body insertions, are needed. The result is cast into the form of a theorem. The cancellation rests on the exclusion principle and does not depend on the special shape of the correlation function. Finally, a generalized hypernetted-chain summation of diagrams which represent the radial distribution function is executed. The procedure includes exchange contributions and can be employed if short and/or long-range correlations are present. (auth)

15978 APPROXIMATE RECOIL APPROACH TO HEAVY-ION INDUCED ONE-NUCLEON TRANSFER REACTIONS. Reisdorf, W. (Centre National de la Recherche Scientifique, 91—Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). Nucl. Phys., A; 242: No. 3, 406-422(5 May 1975).

It is shown that a distorted wave Born approximation theory combining the Hankel function approach for the form factor with a linear recoil correction gives satisfactory results when compared to exact finite-range with recoil calculations for a large variety of heavy-ion induced one-nucleon transfer reactions. The test cases presented involve incident projectile energies in the vicinity of the Coulomb barrier as well as energies several MeV/nucleon above the barrier, strongly absorbing optical potentials as well as recently used more transparent potentials, and transfer with large recoil corrections. The exact calculations are generally reproduced with an accuracy of the order of 10% Computing times are a factor 2 ± 0.5 larger than typical times needed for a no-recoil calculation. The limits of the method are discussed and the importance of the tails of bound states is stressed. (auth)

15979 COMPARISON OF AN OPTICAL POTENTIAL WITH ITS SEPARABLE REPRESENTATIONS. Fully Off-Shell Behavior. Yang, K.-H.; Gerace, W. J.; Walker, J. F. Jr. (Massachusetts Univ., Amherst (USA)). Nucl. Phys., A; 242: No. 3, 365-375 (5 May 1975).

The fully off-shell t matrix elements of a local neutron optical potential are compared with those of separable representations for this potential. Two separable forms, each of which include the effects of three t matrix poles per channel, are used; a single term energy-dependent form and a rank-3 energy-independent form. Although these two representations give fairly equivalent fits to the on-shell and half-off-shell t matrix elements, they have very different fully off-shell extrapolations. This difference is shown to result from the single term nature of the first representation. No conclusion can be made, however, as to which extrapolation is physically more realistic. (auth)

15980 PRELIMINARY RESULTS ON FIXED-JT AVERAGING METHOD FOR MANY-PARTICLE SPECTROSCOPY. Lougheed, G. D.; Wong, S. S. M. (Toronto Univ., Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 243: No. 2, 215-228(19 May 1975).

A practical method based on spectral distribution ideas is introduced to perform nuclear spectroscopic studies. Both the spin and the isospin are treated exactly. Extensive calculations of level densities and level positions are made in the sd shell, and the results are compared with those of the exact shell model. (auth)

15981 A NEW DBWA METHOD FOR TWO-NUCLEON TRANSFER WITH HEAVY IONS. Charlton, L. A. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Nucl. Phys., A; 241: No. 1, 144-150(31 Mar 1975).

A formalism is developed for calculating two-nucleon transfer cross sections. It is intended mainly for heavy-ion induced reactions. The single-nucleon wave functions are expanded in a harmonic oscillator series. A Moshinsky transformation then yields a series of terms containing the relative and c.m. coordinates. It is found that only a limited number of these terms are needed. (auth)

15982 MICROSCOPIC STRUCTURE AND INTEGRAL PROPERTIES OF NUCLEAR HOLE STATES IN THE CONTINUUM SHELL-MODEL APPROACH. Fritsch, W.; Lipperheide, R.; Wille, U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Nucl. Phys., A; 241: No. 1, 79-108(31 Mar 1975).

The structure of hole states as they are observed in direct nucleon removal processes is investigated in the continuum shell-model approach to the hole spectral function. Both microscopic and integral properties of hole states are studied. The role of target ground-state correlations is considered in some detail. Calculations of the spectral function have been performed using a hybrid model in which ground-state correlations are included in second order, whereas correlations in the residual nucleus are treated by exact diagonalization in a configuration space restricted to 1h and 1p-2h states. The effect of a variation of single-particle energies and two-body interaction parameters has been examined. Integral quantities, like shell-model occupation probabilities, mean removal energies and spreading widths, are studied and computed from the microscopically calculated spectral function. The results are discussed in the light of presently available experimental data. (auth)

15983 SPECIAL EXAMPLES OF QUANTIZED FRICTION. Immele, J. D.; Kan, K.-K.; Griffin, J. J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nucl. Phys., A; 241: No. 1, 47-60(31 Mar 1975).

The non-linear velocity potential formulation of quantal friction is studied in several special schematic cases: the spreading of a Gaussian packet, superposition of packets, barrier penetration, and potential resonances. Those features which emerge are unified by the concept of a local fluid velocity to which friction is proportional. (auth)

15984 OSCILLATOR MATRIX ELEMENTS WITH INCLUSION OF THE TENSOR FORCE DERIVED DIRECTLY FROM NUCLEON-NUCLEON PHASE SHIFTS. Sommer, B.; Galonska, J. E.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 241: No. 1, 1-17(31 Mar 1975).

The method of Galonska and Faessler for calculating oscillator matrix elements of the NN interaction is extended for tensor matrix elements. DWBA calculations have been done in S-states using two soft-core potentials from Orsay. The relative matrix elements in the Born approximation are given for all states with $n \leq 3$, $l \leq 2$. Saturation properties of these matrix elements for finite nuclei have been studied. (auth)

15985 NUCLIDIC MASS RELATIONSHIPS AND MASS EQUATIONS. II. Jaenecke, J.; Eynon, B. P. (Michigan Univ., Ann Arbor (USA). Cyclotron Lab.). Nucl. Phys., A; 243: No. 2, 326-348(19 May 1975).

Several explicit numerical solutions of generalized nuclidic mass relationships (partial difference equations) have been derived. These solutions are mass equations with about 230 parameters which reproduce more than 1000 experimental masses with $N,Z \geq 20$ with a standard deviation of about 300 keV. The internal consistency of the solutions and other aspects such as the ability to describe the experimental Coulomb displacement energies are explored. The solutions are compared to the transverse and longitudinal mass equations of Garvey and Kelson and the shell-model mass equations of Liran and Zeldes for their reliability to predict masses of very neutron-rich and proton-rich nuclei. (auth)

15986 SINGLE-PARTICLE POTENTIAL, REARRANGEMENT ENERGY AND EFFECTIVE MASS OF NUCLEAR MATTER, ^{208}Pb AND ^{16}O. Khanna, K. M.; Barhai, P. K. (Birla Inst. of Tech., Mesra, Ranchi (India)). Nucl. Phys., A; 243: No. 2, 298-308 (19 May 1975).

The single-particle potential rearrangement energy and the effective mass of nuclear matter have been calculated using two

density-dependent effective interactions determined in an earlier work. The values of the rearrangement energy for both interactions have been found to be reasonably good compared to the Brueckner–Gammel value. The values of the effective mass also agree very well with those of Brueckner–Gammel and others. An approximate estimate of the 1s single-particle energy for the nuclei ^{208}Pb and ^{16}O has been made using the single-particle potential for the interaction with unequal exchange mixtures. These values of the 1s single-particle energy for both nuclei have been found to be in good agreement with those referred to in the text. (auth)

15987 REDUCTION OF THE LANE-ROBSON "CALCULABLE" REACTION THEORY TO STANDARD R-MATRIX FORM. Philpott, R. J. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Nucl. Phys., A; 243: No. 2, 260-268(19 May 1975).

General dynamical equations derived from the Lane–Robson calculable reaction formalism are cast into a form amenable to standard R-matrix treatment, permitting the resonance content of the equations to be made explicit. Formulae are given which enable the collision matrix and the amplitudes of physical eigenfunctions to be calculated directly from the R-matrix with or without the isolation of resonance contributions. The present methodology permits a significant reduction of effort in numerical investigations of the energy dependence inherent in dynamical models of the nucleus. The formalism is illustrated by calculational results obtained from a potential model fitted to ^{16}O + n scattering data. (auth)

15988 UNIFORM SEMICLASSICAL ORBITAL CALCULATIONS OF HEAVY ION COULOMB EXCITATION. Massmann, H.; Rasmussen, J. O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 243: No. 1, 155-174(12 May 1975).

A new semiclassical approach, which can be derived from Feynman's path integral formulation of quantum mechanics, is applied to multiple Coulomb excitation for backward scattering angles. The basic features of this method are that the dynamics of the problem is treated completely classically (that is, one solves classical equations of motion) but the quantum mechanical superposition principle is retained by evaluating a phase along the classical trajectory and adding probability amplitudes for indistinguishable processes rather than probabilities themselves. One finds even a quantitative agreement with the conventional De Boer–Winther code. The limit of sudden collision ($\xi = 0$) for $\eta \to \infty$ (η = Sommerfeld parameter) is evaluated analytically and is in very good agreement with results published for this case. (auth)

15989 ON SCHEMATIC INTERACTIONS IN SOLVABLE MODELS ESPECIALLY THE QUADRUPOLE PAIRING INTERACTION. Krumlinde, J. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Matematisk Fysik). Nucl. Phys., A; 243: No. 1, 125-142(12 May 1975).

The properties of and the interplay between the monopole pairing, quadrupole pairing and quadrupole particle–hole interactions are studied in two simple, solvable models. (auth)

15990 THE AVERAGE EFFECTIVE INTERACTION IN LINKED CLUSTER THEORY. Goode, P. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Dept. of Physics); Koltun, D. S. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Nucl. Phys., A; 243: No. 1, 44-76(12 May 1975).

A theoretical method is derived for calculating the averages (over J and T) of matrix elements of the nuclear effective interaction, in any order of the linked cluster expansion. This is applied to calculate all terms through fourth order in the G-matrix, for the averages in mass-6 and mass-18 nuclei. It is found that the averages in fourth order are as large as in second and third order. This behavior is associated with a small number of terms, which suggests a partial summation method of improving the series. The relation to other work is discussed. (auth)

15991 THERMODYNAMICAL PROPERTIES OF A PAIRED NUCLEUS WITH A FIXED NUMBER OF QUASI-PARTICLES. Moretto, L. G. (California Univ., Berkeley (USA). Dept. of Chemistry). Nucl. Phys., A; 243: No. 1, 77-99(12 May 1975).

The general formalism for the description of the properties of a paired system with fixed number of quasi-particles has been developed. The number of quasi-particles has been introduced into the pairing Hamiltonian by means of a Lagrange multiplier. The grand partition function and all the other thermodynamical functions have been derived. The formalism has been applied to the uniform model. The properties of the system in the limit of zero temperature have been obtained analytically. It has been found that for temperatures smaller than the critical temperature of the unrestricted system, a first order phase transition from the paired to the unpaired phase occurs when the quasi-particle number is increased isothermally. Above the critical temperature the transition becomes of the second order. The model also predicts that at a fixed quasi-particle number the pairing correlation increases with increasing temperature. In particular, at the highest excitation, and at small quasi-particle number, the pairing correlation is as strong as in the ground state. A rapid decrease and an eventual disappearance of pairing occurs as the system is allowed to relax towards its equilibrium number of quasi-particles. (auth)

15992 SYMMETRY PROPERTIES OF NUCLEI. Proceedings of the Fifteenth Solvay Conference on Physics, Brussels, Belgium, September 28—October 3, 1970. New York; Gordon and Breach, Science Publishers, Inc. (1974). 369p. (CONF-700990-). $40.75.

Separate abstracts are given for the fourteen papers included in the volume. (SDF)

For abstracts of individual papers see: 15514, and 15993–16005.

15993 SYMMETRY OF CLUSTER STRUCTURES OF NUCLEI. Brink, D. M. (Oxford Univ.). pp 1-26 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

Cluster structure in light nuclei is discussed in terms of Hartree-Fock and alpha cluster wave functions. Rotations of nuclei with a cluster structure are studied in the framework of a phenomenological theory and a microscopic theory. An alpha cluster model of ^{20}Ne is used as an example. The phenomenological model of ^{20}Ne is generalized and vibrational modes are calculated. States associated with vibrations of the intrinsic state are constructed using the generator-coordinate method. An attempt is made to show how the symmetry of cluster configurations is a common feature of both phenomenological and microscopic descriptions. (4 figures) (SDF)

15994 VIBRATIONAL MOTION IN NUCLEI. Mottelson, B. R. (Nordita, Copenhagen). pp 27-47 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

Problems relating to the understanding of the connection between collective and independent particle motions in the nucleus are discussed. The role played by the one particle field generated by collective distortion in the average nuclear density is examined. Examples of possibilities for vibrational modes in nuclei and problems associated with the interaction of the excitation quanta among themselves and with other elementary modes of excitation are presented. Included are discussions of shape oscillations, isovector models, spin-dependent models, and pairing modes. (6 figures) (SDF)

15995 SYMMETRY AND STATISTICS. French, J. B. (Univ. of Rochester, NY). pp 63-83 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

The concepts of statistical behavior and symmetry are presented from the point of view of many body spectroscopy. Remarks are made on methods for the evaluation of moments, particularly widths, for the purpose of giving a feeling for the types of mathematical structures encountered. Applications involving ground state energies, spectra, and level densities are discussed. The extent to which Hamiltonian eigenstates belong to irreducible representations is mentioned. (4 figures, 1 table) (SDF)

15996 SL3R SYMMETRY AND NUCLEAR ROTATIONAL STRUCTURE. Biedenharn, L. C. (Duke Univ., Durham, NC). pp 85-99 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

The symmetry SL3R is applied to low lying states of deformed even-even nuclei and comparisons are made with experimental data. Spin and isospin are not included in the algebraic model for certain transition operators presented. It is concluded that SL3R gives a simple algebraic picture of low lying states of a rotator. Viewpoints underlying the work and some of the objections to the approach are cited. (SDF)

15997 SU(3) SYMMETRY IN HYPERNUCLEAR PHYSICS. Lipkin, H. J. (Weizmann Inst. of Science, Rehovot, Israel). pp 101-111 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

Excited states of hypernuclei are described combining several ideas from nuclear physics and particle physics. Strangeness exchange reactions and strangeness analog states are briefly discussed. SU(3) and the symmetry breaking interaction are examined. The results of calculations of excitation energies for strangeness analog states in ^{12}C and a heavy nucleus are presented. The calculation considers states produced by changing a LAMBDA into a proton. (4 figures) (SDF)

15998 REMARKS ON WIGNER'S SUPERMULTIPLET THEORY ON ITS 34th ANNIVERSARY. Radicati, L. A. (Columbia Univ., New York). pp 113-136 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

Useful properties of SU(4) algebra and its application as an approximate nuclear symmetry are detailed with discussion being confined to transitions between nuclear states. The connection between the symmetry of strong interactions and the form of the hadron-lepton coupling in the Wigner theory is illustrated. The validity of the Wigner mass formula, and good agreement for the prediction of the mu capture rate are found. (3 figures, 4 tables) (SDF)

15999 PARITY AND TIME REVERSAL IN NUCLEAR PHYSICS. Frauenfelder, H. (Univ. of Illinois, Urbana-Champaign). pp 137-146 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

A short review treating the status of parity and time reversal invariance in nuclear physics is presented. Unresolved questions are discussed and brief illustrations given. (4 figures) (SDF)

16000 ISOBARIC ANALOG SYMMETRY. Wilkinson, D. H. (Nuclear Physics Lab., Oxford). pp 147-185 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

An experimental comparison is made of nn, pp, and np reactions in a study of charge independence and symmetry. It is concluded that data are consistent with a charge dependence of the nuclear force of order 2 percent in $^1S_0$, the np interaction being stronger than the nn/pp, while charge symmetry is established to 1 percent or better. The isobaric multiplet mass equation and isospin impurity are examined and illustrated with data summaries. Symmetry in both Fermi and Gamow-Teller beta decay is discussed. (8 figures, 63 references) (SDF)

16001 ROTATIONAL MOTION. Bohr, A. (Univ. of Copenhagen). pp 187-210 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

General comments on the occurrence of rotational spectra in quantal systems are offered. Matrix elements for collective transitions are expanded in powers of the angular momentum, and an analysis of systems with axial symmetry is given in terms of Regge trajectories. Physically significant parameters which characterize the intrinsic structure of the system and its coupling to the rotational motion are interpreted. Rotational motion for large quantum numbers is discussed and examples of discontinuities in rotational bands are presented. (1 table, 5 figures) (SDF)

16002 PERMUTATION GROUP IN LIGHT NUCLEI. Kramer, P. (Univ. of Tuebingen, Ger.). pp 211-232 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

From general features of the multiplet scheme, a framework is provided for the application of permutation groups to the structure of light nuclei. It is shown that the description of nuclear states in terms of cluster configurations offers possibilities of finding the best orbital states for a given partition f. The significance of the orbital partition for orbital states is explained in terms of selection rules. Specific methods and results obtained in shell configurations, cluster configurations, and nuclear reactions are discussed. (2 figures, 4 tables, 42 references) (SDF)

16003 OSCILLATOR SYSTEMS. Moshinsky, M.; Quesne, C. (Univ. of Mexico, Mexico City). pp 233-257 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

The analysis is initiated with a discussion of the classical canonical transformations and their unitary representations in quantum mechanics. These ideas are illustrated by the problem of a single particle in a one dimensional harmonic oscillator potential. The extension is made to the Sp(2N) group (representing the dynamical group of the N dimensional harmonic oscillator) and to its subgroup U(N) (symmetry group). Applications of U(N) to problems of particles in a three dimensional harmonic oscillator potential and Sp(2N) to problems of isotropic and anisotropic harmonic oscillator states are discussed. Other simple many body problems are formulated in terms of group theory. (SDF)

16004 NUCLEAR SHELL MODEL IN TERMS OF PSEUDO SPIN-ORBIT DOUBLETS AND PSEUDO SU(3) COUPLING SCHEMES. Hecht, K. T. (Univ. of Michigan, Ann Arbor). pp 301-331 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

Spectra for a system of identical nucleons filling levels of a pseudo spin-orbit doublet, l/j, $(l+2)/j+1$ are examined. Formalism is introduced to show that the energetically favored pair states are the pseudo spin singlet states. The simplified pseudo spin-orbit coupling scheme calculations are found to compare well with detailed shell model calculations. The case of several nearly degenerate single particle states is discussed in terms of the pseudo SU(3) scheme. (9 figures, 2 tables) (SDF)

16005 SHELL-MODEL SYMMETRIES. Elliott, J. P. (Univ. of Sussex, Eng.). pp 333-350 of Symmetry Properties of Nuclei. New York; Gordon and Breach, Science Publishers, Inc. (1974).

From conference on symmetry properties of nuclei; Brussels, Belgium (20 Sep 1970). See CONF-700990-.

The role of symmetry in general and its place within the shell model are discussed. Attention is focused on the SU(3) scheme and its extensions. A short discussion is presented on operations which do not conserve particle number. (SDF)

16006 DYNAMIC EXCITATION IN THE FISSION PROCESS. Ledergerber, T.; Paltiel, Z.; Fraenkel, Z. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics); Pauli, H. C.; Yariv, Y. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)); Schuette, G. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 56: No. 5, 417-420(26 May 1975).

A preliminary report is given on the attempt to understand the excitation mechanism in the fission process. For this purpose a time-dependent Schroedinger equation for the many-body problem, with a semi-realistic driving potential is solved numerically; residual interactions are represented and included by BCS pairing. Two numerical examples are presented which cast some doubt on the usual interpretation of the mechanism as due to "friction". (auth)

16007 DENSITY DEPENDENCE OF THE THREE-BODY CORRELATION ENERGY IN NUCLEAR MATTER. Grange, P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Dept. de Physique Theorique). Phys. Lett., B; 56: No. 5, 439-441(26 May 1975).

Using the formalism of Bethe-Dahlblom, contributions to the binding energy of nuclear matter due to three-body correlations are calculated as a function of density for the Reid soft core potential. Good agreement with Dahlblom's earlier calculation is obtained at low density. At higher density the questionable density dependence is shown to originate from computing off-shell quantities with the bare reference spectrum method. (auth)

16008 INTERNAL CONVERSION AND CORE-POLARIZATION g-FACTORS. Subba Rao, B. N. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. Lett., B; 56: No. 5, 435-438 (26 May 1975).

The penetration parameter, $\lambda(M1)$, in the internal conversion electron emission of 1-forbidden M1 transitions is shown to be proportional to $g_s(eff)/g_p$, the ratio of two g-factors mainly determined by core-polarization effects, and to be uniquely positive in sign. (auth)

16009 MOMENTS OF INERTIA OF FISSIONING ISOMERS. Hamamoto, I. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Lett., B; 56: No. 5, 431-434(26 May 1975).

Moments of inertia of fissioning isomers are estimated by considering both the cranking term and the Migdal term. There is a discrepancy between the measured moments of inertia and the ones estimated by using conventional parameters. (auth)

16010 KINETIC ENERGY CONTRIBUTIONS TO HEAVY ION POTENTIALS. Zint, P. G.; Mosel, U. (Giessen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 56: No. 5, 424–426(26 May 1975).

It is shown that the change in the intrinsic kinetic energies of two interacting heavy ions gives a repulsive contribution to the heavy ion interaction potential. It is proposed that this effect explains a major part of the discrepancy between folded and experimentally determined HI potentials. (auth)

16011 HIDDEN CONFIGURATIONS AND EFFECTIVE INTERACTIONS. A Comparison of Three Different Ways to Construct Renormalized Hamiltonians for Truncated Shell-Model Calculations. Barrett, B. R.; Halbert, E. C.; McGrory, J. B. (University of Arizona, Tucson, Arizona 85721). Ann. Phys. (N. Y.); 90: No. 2, 321-390(Apr 1975).

We discuss in general some criteria and methods for constructing effective Hamiltonians. Then three different methods are compared for constructing an effective Hamiltonian to be used in nuclear shell-model calculations for A = 17 – 20, allowing (A – 16) active nucleons in the $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$ vector space. For all three methods, the aim is to obtain a $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$ model which will simulate the results of a given full $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$, $d_{\frac{3}{2}}$ model. The three methods for finding the effective Hamiltonian are (a) conventional low-order perturbation theory; (b) a projection technique, in which we construct a Hamiltonian whose eigenvalues exactly match a selected subset of $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$, $d_{\frac{3}{2}}$ eigenvalues, and whose eigenvectors exactly match the projections of $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$, $d_{\frac{3}{2}}$ eigenvectors on the $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$ space; and (c) least-square fit to selected $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$, $d_{\frac{3}{2}}$ energies. When the effective Hamiltonians are limited to 1-body and 2-body terms, the least-square method yields the best overall fit. However, the (1 + 2)-body effective Hamiltonians obtained by the perturbation method and by the projection method also yield qualitative agreement with $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$, $d_{\frac{3}{2}}$ energies. The 3-body-operator terms calculated via the perturbation method are quite different from those calculated by the projection method, sometimes worsening the agreement. For all Hamiltonians studied, the $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$ eigenvectors strongly resemble projections of the $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$, $d_{\frac{3}{2}}$ eigenvectors on the $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$ space. The role of "intruder" states in effective-Hamiltonian studies is discussed. (RWR)

16012 DIRECT REACTIONS AND HAUSER-FESHBACH THEORY. II. NUMERICAL METHODS AND STATISTICAL TESTS. Hoffmann, H.M.; Richert, J.; Tepel, J.W. (Max-Planck Institut für Kernphysik, Heidelberg, West Germany). Ann. Phys. (N.Y.) 90: No. 2, 391-402 (Apr 1975).

Numerical methods and statistical tests are described which form part of a recent paper dealing with Hauser-Feshbach theory in the presence of direct reactions. (auth)

16013 DIRECT REACTIONS AND HAUSER-FESHBACH THEORY. Hofmann, H.M.; Richert, J.; Tepel, J.W.; Weidenmüller, H.A. (Max-Planck-Institut für Kernphysik, Heidelberg, W. Germany). Ann. Phys. (N.Y.) 90: No. 2, 403–437(Apr 1975).

In the presence of direct reactions, the calculation of energy-averaged cross sections, polarizations, analyzing powers, etc., in terms of the energy-averaged S-matrix is possible with the help of a unitary transformation U, defined as the matrix which diagonalizes Satchler's transmission matrix. For a fixed number of channels and in the limit of a very large number N of compound nucleus resonances, we show analytically that the transition from the originally given statistical scattering matrix S to the matrix $\tilde{S} = USU^T$ reduces the Hauser-Feshbach problem with direct reactions to the one without. The analytical proof is supported by numerical calculations which show that the results are valid on the 2 to 3% level of statistical accuracy of the numerical calculations for values of N as small as 100. We also show analytically that in the absence of direct reactions, energy-averaged cross sections depend only upon the transmission coefficients. The form of this dependence, as well as the dependence on the transmission coefficients of other quantities needed for the evaluation of cross sections in the presence of direct reactions, is parametrized by simple fit formulas which, while lacking theoretical support, give a very satisfactory overall representation of our numerical results. (auth)

16014 PION SUPERFLUIDITY IN NUCLEAR MATTER. Goble, D.F. (Department of Physics, Dalhousie University, Halifax, Nova Scotia). Ann. Phys. (N.Y.) 90: No. 2, 295-320 (Apr 1975).

We utilize analogies with theories and properties of both liquid He^4 and electrons in solids and liquids in constructing a model of nuclear matter in which the presence of stabilized pions is assumed. This model is then used to predict relationships between various thermodynamic parameters of a nuclear matter system, such as that between its "free" pion density and the characteristic transition temperature at which a Bose-Einstein condensation will commence. (auth)

16015 IS THE DEFORMATION PARAMETER β DIFFERENT FOR DIFFERENT KINDS OF TRANSITIONS? Madsen, V.A. (Oregon State University, Corvallis, Oregon 97331); Brown, V.R.; Anderson, J.D. Phys. Rev. Lett. 34: No. 22, 1398-1400 (2 June 1975).

It is shown on the basis of isospin arguments that the deformation parameter β_2 for 2^+ first excited states is expected to be a function of the external field producing the transition. This is contrary to the usual assumption based on the collective model that β is an intrinsic property of the nucleus and is, therefore, the same for all kinds of transitions. Data available in the literature support the expectation. (auth)

16016 STATISTICAL METHODS IN NUCLEAR THEORY. Shubin, Yu.N. Sov. J. Part. Nucl. 5: No. 4, 413-433 (Apr 1975).

This review outlines the statistical methods widely used to describe the properties of excited states of nuclei and nuclear reactions. The basic physical assumption underlying the known distributions of level spacings (the Wigner and Poisson distributions) and reduced partial widths (the Porter–Thomas distribution) are discussed, as are the relations used in the average-cross-section calculations and in autocorrelation analysis. (auth)

16017 ELASTIC AND INELASTIC SCATTERING OF ELECTRONS BY NUCLEI. Luk'yanov, V.K.; Pol', Yu.S. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 4, 385-412 (Apr 1975).

A review is presented of the present status of theoretical methods and of the principal results of their application to elastic and inelastic scattering of electrons by nuclei with excitation of low-lying collective status in the nuclei. The advantages and shortcomings of phenomenological methods and model-independent methods for analyzing the experimental data are considered. The possibilities are demonstrated of directly describing the data within the framework of the independent-particle model, of the α-cluster model, of approaches with allowance for the short-range correlations in the nuclei, and of the macroscopic and microscopic nuclear models. (auth)

16018 REMARK ON THE QUANTIZATION OF THE NUCLEAR PSEUDOMAGNETIC ROTATING FIELD. Odehnal, M. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). Phys. Lett., A; 53: No. 1, 9-10(19 May 1975).

It is shown that the nuclear pseudomagnetic rotating field can be formally described by Schwinger's boson operators of two harmonic oscillators and the states of this field as a product of two Glauber coherent states formed by super-position of angular momentum states. (auth)

16019 AN APPROACH TO THE DESCRIPTION OF QUASI-BANDS IN NUCLEI NEAR DOUBLE CLOSED SHELLS. Tanaka, Y.; Sheline, R. K. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Phys. Lett., B; 56: No. 4, 309-312(12 May 1975).

Quasi-band structures in nuclei near double closed shells are shown to be well described by the aligned coupling scheme wave functions. This alignment of nucleons in their magnetic substates occurs for nuclei such as ^{40}Ar, ^{56}Fe and ^{41}K which are presented as examples. (auth)

16020 MICROSCOPIC STATISTICAL THEORY OF PRECOMPOUND AND COMPOUND NUCLEUS REACTIONS. Agassi, D.; Weidenmueller, H. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Phys. Lett., B; 56: No. 4, 305-308(12 May 1975).

Starting from the statistics of the nuclear matrix elements, a generalized master equation which contains the usual master equation for precompound processes, and the Hauser–Feshbach formula, as special cases is derived. Further results, limitations, and possible generalizations of the approach are indicated. (auth)

16021 THE ^{6}Li-α-d VERTEX CONSTANT. Lim, T. K. (Drexel Univ., Philadelphia, Pa. (USA)). Phys. Lett., B; 56: No. 4, 321-324(12 May 1975).

A critical comparison is made of the vertex constant, C_0^6Li-α-d, derived from various sources. It is found that the extracted values fall into two distinct sets. Arguments are presented for preferring those values which collect around the larger figure C_0^6Li-α-d on the order of 5.7, which is favored by a majority of realistic α-d intercluster wave functions, and photodisintegration, transfer-reaction and quasifree-scattering data. (auth)

16022 EXACT FINITE-RANGE DWBA TREATMENT OF HEAVY-ION-INDUCED REACTIONS TO UNBOUND RESIDUAL STATES. Ray, L.; Coker, W. R.; Udagawa, T. (Texas Univ., Austin (USA). Dept. of Physics). Phys. Lett., B; 56: No. 4, 318-320(12 May 1975).

It is shown that when one considers heavy-ion-induced direct nuclear reactions, the narrowly localized reaction surface makes a traditional approximation used in analysis of light-ion reactions to particle-unbound states a very poor one. Even for unbound states having single-particle widths 10^{-5} of their resonance energies, quite different heavy-ion angular distributions are predicted using weakly-bound states versus more realistic complex-energy eigenstates (Gamow states). (auth)

16023 MICROSCOPIC DESCRIPTION OF THE REAL ALPHA-NUCLEUS POTENTIAL AT LARGE DISTANCES. Eisen, Y.; Day, B. (Argonne National Lab., Ill. (USA)); Friedman, E. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). Phys. Lett., B; 56: No. 4, 313-317(12 May 1975).

The real part of the alpha-nucleus potential is calculated by double folding shell-model matter distributions of the projectile and target nuclei with effective nucleon-nucleon potentials obtained either phenomenologically, or microscopically from the Reid soft-core potential. Comparisons are made with experimental alpha-scattering data at incident energies near the Coulomb barrier, where effects due to the imaginary potential at large distances are negligibly small. The range of the effective nucleon-nucleon force at intermediate distances and the effective nucleon-alpha interaction are investigated. (auth)

16024 REAL CENTRAL OPTICAL POTENTIALS FOR LIGHT COMPOSITE PROJECTILES. Matoba, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91—Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Phys. Lett., B; 56: No. 4, 332-334(12 May 1975).

The volume integrals of the real central optical potentials for deuteron ^{3}He, and α-particle scattering on nuclei have been analyzed by the prescription of Watanabe. A large reduction, -31 ± 2 MeV, in the nuclear potential for α-particles has been found in the energy range 104-166 MeV. (auth)

16025 ENERGY PARTITIONS IN FISSION. Datta, R. (Saha Inst. of Nuclear Physics, Calcutta (India)). Phys. Lett., B; 56: No. 4, 325-328(12 May 1975).

Energy partition in fission is reconsidered for ^{234}U in the RGM-PES model with explicit linear momentum conservation for fission up to about 25 MeV excitation. Several qualitative differences with earlier predictions are pointed out. There is need of specific experiments to verify them. (auth)

16026 THE GENERATOR COORDINATE METHOD AS AN APPROXIMATION TO THE SHELL MODEL. A Comparison on ^{24}Ne. Goeke, K.; Mihailovic, M. V. (Oxford Univ. (UK). Dept. of Theoretical Physics); Allaart, K. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.); Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 243: No. 3, 440-448(26 May 1975).

The applicability of the generator coordinate method as an approximation to the complete shell model diagonalization is tested in the sd shell on ^{24}Ne. The quadrupole moment and the pairing energy are used as generator coordinates and a constrained Hartree-Bogoliubov solution projected on the subspace of good angular momentum and good proton and neutron number is chosen as generating functions. The spectra obtained by the generator coordinate method and the complete diagonalization show good overall agreement. Also some conclusions about the nature of some low-lying states in ^{24}Ne, interpreted in terms of vibrations are drawn. (auth)

16027 NEUTRON TRANSFER INTO RESONANT STATES. Moehring, K.; Lipperheide, R. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik); Cole, B. J. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Nucl. Phys., A; 243: No. 3, 365-379(26 May 1975).

The description of neutron stripping into resonant states as off-shell scattering and the connection of the differential transfer cross section with the total neutron cross section for the same target is formulated including distortion in the initial and final channels, and interference with the coherent, non-resonating proton transfer. The experimentally observed strong dependence of the ratio of these two cross sections in resonance on the transferred orbital angular momentum is quantitatively explained by three effects: the off-shell behavior of the neutron scattering amplitude, the absorption in the distorting optical potentials, and the influence of interference with non-resonant processes. At low excitation energies of the resonances, the overriding effect is the off-shell behavior of the neutron scattering amplitude, leading to strong enhancement of the stripping cross section relative to the neutron cross section. (auth)

16028 PAIRING EFFECTS ON THE MASS TENSOR FOR SPONTANEOUS FISSION. Jensen, A. S.; Miranda, A. (Aarhus Univ. (Denmark)). Nucl. Phys., A; 244: No. 1, 93-106(2 Jun 1975).

The monopole and quadrupole pairing effects on the fission mass tensor are considered. Two possible definitions of the quadrupole pairing matrix elements are investigated. They differ in dependence on deformation, leading to different behavior of the mass parameter with changing deformation. The effects of the usually neglected RPA terms are given in a simple expression. With monopole pairing alone the RPA terms do not contribute to the mass tensor, whereas the quadrupole pairing may have significant effects. Quantitative studies are carried out for a simple model which contains the important realistic features. (auth)

16029 VARIATIONAL PRINCIPLES FOR SCATTERING IN THE GENERATOR COORDINATE METHOD. Beck, R.; Borysowicz, J.; Brink, D. M.; Mihailovic, M. V. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., A; 244: No. 1, 45-57(2 Jun 1975).

The generator coordinate method (GCM) wave function is used as a trial function in a Kohn type variational principle for scattering phase shifts. It is shown that a GCM trial function is a solution of the variational equations if the Hill-Wheeler integral equation is satisfied subject to an appropriate boundary condition. A new method for introducing the scattering boundary condition is presented. There is a uniqueness theorem for the phase shift. (auth)

16030 COULOMB POTENTIALS IN HEAVY-ION INTERACTIONS. Devries, R. M.; Clover, M. R. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Nucl. Phys., A; 243: No. 3, 528-532(26 May 1975).

The usual point charge approximation for the Coulomb potential in heavy-ion interactions is compared with more realistic treatments. Elastic scattering and transfer reaction calculations appear to be insensitive to the form of the Coulomb potential used. (auth)

16031 NUCLEAR RESPONSE IN THE CONTINUUM. Shlomo, S.; Bertsch, G. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Phys., A; 243: No. 3, 507-518(26 May 1975).

Continuum effects may be easily treated in the RPA particle-hole theory of excitations if the calculation is done with the response function formalism. The theory is applied to the low multipolarities in ^{16}O, ^{40}Ca, and ^{208}Pb. It is confirmed that the width of the giant dipole state in light nuclei is accounted for by the continuum. In heavy nuclei the dipole decay width is relatively small. The giant quadrupole state is predicted to be much narrower than the dipole since it is concentrated in a single state. The $3\hbar\omega/2\pi$ octupole state is quite spread out in light nuclei, but has a width of only 1 MeV in ^{208}Pb. (auth)

16032 "BACKBENDING" IN THE STEPHENS-SIMON MODEL. Damgaard, J.; Kusuno, S.; Faessler, A. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 243: No. 3, 492-506(26 May 1975).

In an attempt to understand the backbending phenomena observed in the rare-earth region a model representing an extension of the rotational alignment scheme has been investigated. It is found, even including attenuation of the Coriolis matrix elements and taking into account the sensitivity of the results on the single-particle spectrum used, that it appears at the moment impossible to decide whether such a model ultimately may lead to an explanation of the observed changes in the nuclear moment of inertia. (auth)

16033 SOLID NEUTRON MATTER. Takemori, M.T.; Guyer, R.A. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. D 11: No. 10, 2696-2723 (15 May 1975).

The ground state of solid neutron matter is investigated using the t-matrix formalism developed for the quantum crystal problem. Studies of neutrons interacting through the repulsive part of the Reid $^1S_0$ interaction, the Reid $^1S_0$ interaction, and the full Reid potentials are made in the Hartree, Hartree t-matrix, Hartree-Fock, and Hartree-Fock t-matrix approximations. The results of the studies of the two model problems, the repulsive part of the $^1S_0$ interaction and the $^1S_0$ interaction, are exhibited and discussed in detail. These model problems provide a test of the computational procedures employed in using the quantum crystal formalism on the neutron matter problem. The result of the study of neutrons interacting through the Reid soft-core potentials is described. We find no evidence in the study of either of the model problems for the presence of a solid ground state. Further, we find no evidence in the study of neutrons interacting through the full set of Reid soft-core potentials for the presence of a solid ground state. (auth)

16034 TWO-PARTICLE TRANSFER REACTIONS: A FOUR-BODY TREATMENT I. Hussein, M.S. (Pelletron Laboratory and Physics Department, University of São Paulo, São Paulo, Brasil). Ann. Phys. (N.Y.) 90: No. 1, 48-70 (Mar 1975).

A method is proposed through which interaction between transferred nucleons can be introduced to all orders. The transition amplitude for the two-nucleon transfer reaction is thus obtained showing the relevant two-particle transition amplitude that decribes the interaction between the transferred nucleons. In the presence of two-body bound state in the transferred pair the total cross section is split into two parts one describing the transfer of a bound system of two nucleons, the other part corresponds to corrections due to the continuum. General remarks about the application of these ideas to heavy-ion scattering are made. (auth)

16035 ANOMALY OF THE MOMENT OF INERTIA AT HIGH SPIN STATES AND PAIRING VIBRATIONS. Faessler, A. (Kernforschungsanlage, Juelich, Ger.). Nukleonika; 20: No. 2, 57-86 (1975).

Theoretical explanations for the anomaly of the moment of inertia at high spin states ("backbending") are discussed. A connection between the neutron pairing vibrational band and backbending is shown. One starts from the assumption that backbending is due to the intersection of two bands. The only thing which is still contested is the nature of the second band. Two types of explanations of the nature for the second band are discussed: Phenomenological explanations which start from the deformation energy surface and more microscopic explanations which use the interplay between pairing and the Coriolis force. The microscopic models of Coriolis antipairing (CAP) and of rotational alignment (AL) are discussed in detail. Experimental data about the second band suggest that the second band is the neutron pairing vibrational band. CAP and AL effect are then two extreme cases of this hypothesis: For a strongly collective pairing vibrational band one has the CAP limit. If the pairing vibrational band is only weakly collective, it consists of almost only one two-quasi-particle pair aligned by the Coriolis force as in the AL effect. Methods for describing backbending by the intersection of the neutron pairing vibrational and the ground state rotational band are explored using the generator-coordinate method. (26 figures, 4 tables, 65 references) (auth)

16036 NUCLEAR ROTATIONAL STATES IN A GENERAL SINGLE PARTICLE MODEL. Mang, H. J. (Technische Univ., Munich). Nukleonika; 20: No. 2, 87-102(1975).

Hartree-Fock-Bogolyubov theory and angular momentum projection techniques are used to "derive" the Inglis cranking model without recourse to semiclassical arguments. Results of applications to even and odd mass nuclei are presented. Agreement between theory and experiment is astonishingly good in view of the simple model Hamiltonian and the small configuration space that has been used. The interaction is just a sum of pairing and a quadrupole-quadrupole force. (2 tables, 6 figures) (auth)

16037 MICROSCOPIC THEORY OF DEFORMED ODD NUCLEI. Hara, K. (Technical Univ., Garching, Ger.). Nukleonika; 20: No. 2, 103-132(1975).

The attenuation of the Coriolis interaction in the deformed nuclei is discussed from the microscopic point of view. It is shown that the dynamical correction to the ordinary Coriolis coupling (kinematical) arises from the fact that the self-consistent potential violates the rotational symmetry. The theory is applied to the positive-parity bands in the neutron-odd rare-earth nuclei where many recent data are available. (5 tables) (auth)

16038 GENERALIZED-ROTATIONAL BASIS AND THE DEFORMED QUASI-PARTICLE BASIS FOR NUCLEAR STRUCTURE CALCULATIONS. Kumar, K. (Vanderbilt Univ., Nashville). Nukleonika; 20: No. 2, 133-162(1975).

The virtues, limitations, and possible extensions of two wavefunction bases are discussed in some detail. The Generalized-Rotational basis may be employed for understanding deviations from the rotational model. It can also be combined with a general, microscopic basis called Deformed-Quasi-Particle basis. Some form of a DQP basis is employed in many nuclear structure calculations. Here we emphasize several extensions and modifications of this basis: (i) Inclusion of nuclear angular momentum at an early stage. (ii) Inclusion of higher quasi-particle states such as 2, 4, ... quasi-particle states in even-A nuclei and 3, 5, ... quasi-particle states in odd-A nuclei. General relations for the matrix elements of one-body and two-body operators are given. A new method for the determination of U, V factors for a general, two-body interaction is presented. The TDHB, CHB, PHB and Diagonalization methods of restoring the rotational and particle-number symmetries of the DOP basis are discussed. Some details of a simple model, pairing-plus-quadrupole interaction in a single-j shell, are given. (3 tables, 46 references) (auth)

16039 SINGLE-PARTICLE STATES IN NUCLEI. Jeukenne, J. P.; Lejeune, A.; Mahaux, C. (Univ., Liege). Nukleonika; 20: No. 2, 181-198(1975).

The success of the shell-model and of the optical model implies the existence of quasi-stable single-particle states in atomic nuclei. We review the theoretical description of these quasi-particles. We describe an expansion for the calculation of their energy and life-time in nuclear matter. This approach is used to compute the optical-model potential, starting from Reid's hard core nucleon-nucleon interaction. Good agreement with empirical values is obtained. The optical-model potential in finite nuclei is calculated from a local density approximation. (10 figures) (auth)

16040 APPLICATION OF DENSITY-DEPENDENT FORCES FOR THE CALCULATION OF NUCLEAR STRUCTURE. II. Nemeth, J. (Lorant Eotvos Univ., Budapest). Fiz. Szemle; 24: No. 12, 372-376(Dec 1974). (In Hungarian).

After reviewing the mechanism of fission, on the basis of the liquid drop and the Strutinsky models, the Hartree-Fock calculations and the Thomas-Fermi approximation, it is shown how to derive the density distribution of the deformed nucleus, the single-particle potential and the total energy. In the case of a heavy nucleus, e.g., ^{240}Pu, the ground state does not have the expected spherical symmetry but is slightly deformed, as has been also confirmed experimentally. Calculations were made to determine whether this is caused by density dependent forces, taking the charge exchange potential into account. The calculations with the density-dependent potential were carried out for the P scattering of ^{48}Ca. (TTT)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 13922, 14505, 14526, 14534, 15440, 15771, and 16053.

16041 (KIYI-74-27) DEPENDENCE OF THE SUBSTANCE STOPPING POWER ON THE EXTENT OF THE ELECTRON SHELLS FILLING. Chesnokova, T. D.; Pucherov, N. N. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1974. 8p. (In Russian). INIS.

As a result of analyzing the atomic stopping power of substances for protons having energies up to 20 MeV it was found that the stopping power depends on the structure of the electron shells of the atoms. (SJR).

16042 FRACTIONATION OF THE SINGLE DOSE AND ITS EQUIVALENTS. Suriol, M. B.; Planas, J. G. (Univ. of Barcelona). Int. J. Radiat. Eng.; 1: No. 6, 585-590(Dec 1971).

The practice of the single dose technique in cases where fractionated dose radiotherapy is not practicable is discussed. Data obtained by several authors, practicing diverse fractionation procedures were analyzed regarding correlations between dose and time of fractionated treatment. These data were then used to derive several mathematical expressions and to calculate their constants. This allowed derivation of equivalencies of the single dose treatment. Some practical uses of these expressions and their constants are discussed, demonstrating experimental verification of the theoretical predictions. (auth)

16043 MORE DATA ON THE ENERGY CHANGE OF X RAYS IN A MOUSE PHANTOM. Scarpa, G.; Moscati, M.; Roca, V. (CNEN, Casaccia, Italy). Phys. Med. Biol.; 20: No. 2, 321-326 (Mar 1975).

A rough assessment of the quality of an x-ray beam under different irradiation conditions can be obtained from measurements of the variations in half value layer (HVL) for copper. Sintered undoped BeO (Thermalox 995) was used as TL detector, and the irradiations were performed in free air, under full backscattering conditions or in the central axis of a cylindrical nylon mouse phantom resting on a platform and surrounded by a number of additional phantoms (i.e. simulating the conditions of many radiation biology experiments). The results indicated that about half of the energy degradation in the mouse phantom was due to backscattered radiation, and half to side- and forward-scattering processes. (UK)

16044 CHARACTERISTICS OF A NEGATIVE PION BEAM IN A THERAPEUTIC APPLICATION. Richman, C. (Los Alamos Scientific Lab., NM). Radiology; 116: No. 1, 187-189(Jul 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(1 Dec 1974).

Lithium-drifted silicon detectors were used to investigate the components of the pion beam at the Los Alamos Meson Physics Facility. The components of the incoming beam are about 5 percent electrons, 10 percent muons, and 85 percent pions. Pulse spectra of the incoming beam and of the "stars" produced by the pions were obtained in a phantom. The analysis of the spectra into different LET components showing where pions are most effective is presented. (auth)

16045 RADIATION PHYSICS AND DOSIMETRY. Generalova, V. V.; Lenchenko, V. M. Int. J. Radiat. Eng.; 1: No. 6, 591-598 (Dec 1971).

The discrepancies in the values of G obtained by different authors are attributed to the dependency of G on a series of factors which include radiation type and spectrum, the nature of the dosimetric system, the presence of impurity centers and defects, the geometry and the environment. It is demonstrated that accurate calculation of G by several possible methods requires the solution of problems involving cascade multiplication of fast Compton, photo, and δ-electrons, and activation of diffusion controlled processes by electron excitation and ionization. Attempts to determine the energy spectra of interacting Compton, photo and δ-electrons by studying the effect of radiation energy on dosimetry phenomena in homogeneous systems, the energy distribution near interfaces, and the time dependence of the charging of dielectric–metal systems, have been successful. (auth)

16046 ON A METHOD FOR SAMPLING THE ENERGY LOSS IN ELECTRON TRANSPORT. Vande Putte, D. W.; Cusens, D. J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Isotopes and Radiation Div.). Phys. Lett., A; 51: No. 7, 393-394 (21 Apr 1975).

A biased sampling method is proposed, allowing the use of the Blunck-Westphal energy loss distribution in Monte Carlo electron transport. (auth)

16047 DEPTH DOSE MEASUREMENTS WITH Co-60 GAMMA RAYS IN PLEXIGLASS USING LiF-100-DOSEMETERS. Horoba, C. Muenster, GE; Muenster Univ. (1974). 58p. (In German). INIS.

Thesis.

The decrease of thermoluminescence of LiF-TLD-100-sticks irradiated with 300 R cobalt-60 gamma rays with increasing thickness of plexiglas covers and with a constant 50 cm distance focus-cover surface was quantitatively studied. An almost complete agreement could be observed between the depth dose values in plexiglas and values reported for cobalt-60 gamma rays in water. (GE)

16048 INTEGRAL TISSUE DOSES AND INTEGRAL DOSES IN MEDIA WITH NON-HOMOGENEOUS ABSORPTION CAPACITY. Chvojka, Z.; Dubinin, I.; Janousek, Z. (Katedra Radiologie a Nuklearni Mediciny, Brno). Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.; 16: No. 3, 219-223(1973). (In Czech).

General postirradiation reactions result partly from the toxic damage induced by the products originated from destroyed tissues and partly from the damage to the individual radiosensitive tissues and systems. Supposing the other factors (the time factor, the manner of fractionation, the irradiated volumes of the individual systems, etc.) to be constant, the general postirradiation reactions are the function of the total integral dose and the integral doses absorbed in the individual systems. The latter differ in their density and in the atomic composition, thus both the quantity of the absorbed radiation energy and the mechanism of absorption. On the basis of a simple equation of the curve of depth doses, its application to a non-homogeneous medium, and from the relation for the absorbed dose, the expressions are derived for the calculation of tissue–and total integral doses in a non-homogeneous medium. (auth)

16049 CALCULATIONS OF THE ENERGY LOSS OF ^{4}He IONS IN SOLID ELEMENTS. Chu, W.K.; Moruzzi, V.L.; Ziegler, J.F. (IBM Research, Yorktown Heights, New York 10598). J. Appl. Phys. 46: No. 7, 2817-2820 (July 1975).

We have calculated the energy loss of ^{4}He ions in a number of elemental and rare-gas solids in the energy range from 0.4 to 4.0 MeV. The calculations are based on the Lindhard-Winther energy-loss formalism and use solid-state charge densities for the target atoms. Stopping cross sections ϵ_a are presented as a function of projectile energy and are compared with the Hartreee-Fock-Slater isolated-atom calculations and semiempirical cross sections. It is found that the solid-state charge densities generally produce a somewhat better energy dependence than the atomic charge densities but that neither produces an adequate fit in the low-energy region. In particular, solid-state effects of Ne and Ar lead to a 4–10% increase over the atomic calculations. (auth)

16050 EVIDENCE FOR AN ALIGNMENT EFFECT IN THE MOTION OF SWIFT ION CLUSTERS THROUGH SOLIDS. Gemmell, D.S. (Sektion Physik der Universität München, Munich, West Germany); Remillieux, J.; Poizat, J.; Gaillard, M.J.; Holland, R.E.; Vager, Z. Phys. Rev. Lett. 34: No. 23, 1420-1424 (9 June 1975).

Distributions in angle and in energy have been measured for ions transmitted through thin solid targets bombarded by various molecular-ion beams. The results, which differ markedly from those expected from simple Coulomb explosions, indicate that for the ion clusters created inside the target, the internuclear vectors tend to align with the beam direction. An explanation is suggested in terms of a wake potential generated behind each particle as it traverses the solid. (auth)

16051 MEASUREMENT OF ABSORBED FRACTIONS FOR PHOTON SOURCES DISTRIBUTED UNIFORMLY IN VARIOUS ORGANS OF A HETEROGENEOUS PHANTOM. Garry, S. M.; Stansbury, P. S.; Poston, J. W. (Oak Ridge National Lab., TN). Health Phys.; 28: No. 5, 591-597(May 1975).

A physical representation of the Snyder-Fisher heterogeneous mathematical phantom has been designed and constructed. The physical phantom contains skeletal components, lungs and soft-tissue regions similar to the mathematical Snyder-Fisher phantom. The phantom is suitable for studies of radiation dose distributions involving both internally and externally applied radiation fields. A description of the phantom and its composition is given. Dose distributions were measured within the phantom resulting from photon emitters distributed uniformly in selected organs. These distributions were used to calculate absorbed fractions for

the mathematically defined phantom organs. These absorbed fractions are given and compared with the absorbed fraction estimates by Snyder et al (MIRD Pamphlet No. 5. J. Nucl. Med.; 10: Supplement No. 3, 5 (1969)). In general, estimates of the absorbed fractions, obtained experimentally, fall within the range of twice the standard deviation of the calculated value. (auth)

Radiation Protection Standards

Refer also to abstract 16596.

16052 (NP-20456, pp vp Paper 7) BACKGROUND ON RADIATION PROTECTION STANDARDS. Rogers, L. (Atomic Energy Commission, Washington, DC). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Recommendations are presented of the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP) and the Federal Radiation Council (FRC). The following topics are considered: radiation protection guides, numerical maximum permissible doses for workers, dose limits for exposure to individuals in the population; and average exposures to the total population. (HLW)

16053 THOUGH IT'S BEEN SAID MANY TIMES, MANY WAYS: SPECTROMETRY IN DOSIMETRY. Thorngate, J. H. (Oak Ridge National Lab., TN). Health Phys.; 28: No. 5, 633-634(May 1975).

It is stated that knowledge of the energy spectrum is a prerequisite for careful dosimetry. Despite this, few are actively engaged in this work, and it is difficult to obtain funding. It is stressed, not for the first time, that to increase sophistication in assessing radiation risk, dosimetrists must rely heavily upon spectrometric measurements. (UK)

16054 SMALL QUANTITIES: END-LIFE OF RADIOACTIVE MATERIALS. Tulley, T. J. (Royal Infirmary, Hull, Eng.). Health Phys.; 28: No. 5, 634(May 1975).

The concept of "end-life" of a quantity of radioactive material is considered and defined as that period in which the probable number of radioactive atoms present is reduced to unity. This concept could be useful in assessing some disposal problems. Examples of values of end-life are given. It is pointed out that for real materials long-lived impurities are the nuclides which will determine the end-life of the whole. (UK)

Shielding Calculations and Experiments

16055 (CONF-750624-1) PERTURBATION THEORY AND SENSITIVITY ANALYSIS FOR TWO-DIMENSIONAL SHIELDING CALCULATIONS. Childs, R. L.; Bartine, D. E.; Engle, W. W. Jr. (Oak Ridge National Lab., Tenn. (USA)). 1974. 6p. Dep. NTIS $4.00.

From American nuclear society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The development and implementation of perturbation theory methods for two-dimensional shielding problems are described. Cross section sensitivity results are obtained by calculating the effect of varying each individual cross section parameter. (auth)

16056 TRANSMISSION OF PHOTONS THROUGH COMMON SHIELDING MEDIA. Jones, T. D.; Haywood, F. F. (Oak Ridge National Lab., TN). Health Phys.; 28: No. 5, 630-632 (May 1975).

An analysis of existing transmission factors is given which is primarily intended for shielding applications and is expected to give accurate and consistent results to a penetration depth of four mean free paths which corresponds to about 2%. Slabs of shielding media were assumed to be irradiated normally by broad beams of monochromatic photons. Kerma "buildup" factors for Fe and H_2O and for ordinary concrete were interpolated and extrapolated as a function of energy in order to span the range of the energy spectra from a typical thermonuclear weapon at 1200 m and from fission product γ rays. The ratio of the broad beam buildup factor to the corresponding point isotropic buildup factor as a function of energy (0.5 MeV to 10 MeV), penetration depth and materials (H_2O, concrete, Fe, Sn, U), and also the transmission of photon dose through Fe, concrete, soil, H_2O and wood, are tabulated. (UK)

PHYSICS (THEORETICAL)

General

Refer also to abstract 15740.

16057 (CNRS-CPT-74-P-662) SPECTRAL PROPERTY OF TRANSFER MATRIX OPERATOR FOR A ONE-DIMENSIONAL SYSTEM IN CLASSIC STATISTICAL MECHANICS. Ferrero, P. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Oct 1974. 4p. (In French). INIS.

On a suitable space of continuous functions, the transfer matrix L defined for a one-dimensional lattice gas is shown to be compact, if the interaction is two-body, translation invariant and of polynomial-exponential type. (auth)

16058 (JUL-1097-MA) INTEGRATION OF PRODUCTS OF SPHERICAL BESSEL FUNCTIONS WITH POWERS OF X. Profant, M.; Poeppe, C. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Angewandte Mathematik). Aug 1974. 37p. (In German). INIS.

2 tabs.

A collection of formulas is given for the integration of products of spherical Bessel functions with powers of x, often used in the solution of three-dimensional elliptic differential equations (e.g., diffusion equation with drift-term). (GE)

16059 CANONICAL FORMALISM FOR AN ACCELERATION DEPENDENT LAGRANGIAN. Ellis, J. R. (Univ. of Sussex, Eng.). J. Phys., A (London); 8: No. 4, 496-505(Apr 1975).

The method of "Hamilton multiplier functions" is applied to a relativistic Lagrangian containing a four-acceleration. A recent formulation, in which it is stated that the current theory of multipliers does not correctly handle the subsidiary conditions on the canonical variables that arise from the first-order Lagrange equations of motion, is later considered in the context of the example given. (auth)

16060 NUMBER OF NEW APPROACHES TO INVESTIGATING THE PROPERTIES OF A GENERALIZED WKB-APPROXIMATION. IV. Zhirnov, N. I.; Sokolov, A. A. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 62-67(1975). (In Russian).

By means of a new formalism of a generalized WKB-method a look is taken at the problem of calculating the partial phases of scattering particles on spherically-symmetrical potentials. An estimate is obtained of the error which is allowable in calculating the scattering phases at a zero approximation of the method. (SJR)

16061 CERTAIN GROUP PROPERTIES OF EQUATIONS OF THE RELATIVISTIC FIELD OF THE SPIN ½ AND 1. Vladimirov, S. A. (Dnepropetrovsk State Univ., USSR). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 4, 294-296(Apr 1975). (In Ukrainian).

The invariance properties are studied for the system S of the differential equations $a^{\mu j}_{\alpha}(x,u)\frac{\partial u^{\alpha}}{\partial x^{\mu}} = f^{j}(x,u)$, ($\mu$ = 1,2,...M; α = 1,2,...K; j = 1,2,...N) relative to the operators $\hat{X} = \xi^{i}(x,u)\partial/\partial x^{i} + \eta^{\alpha}(x,u)\partial/\partial u^{\alpha}$. The determinative equations of the group admissible by the system S are obtained in the explicit form. They appeared to decompose into independent parts which can be solved in succession. This fact permitted one to prove that the coordinates ξ^{i} operator of S the symmetry operator admissible by the arbitrary system of relativistic interacting fields of spin ½ and I depend on x,y,z,t only. The interaction was supposed to be added only to the right-hand sides of the corresponding equations. (auth)

16062 THEORY OF RADIATION FROM A POINT CHARGED PARTICLE MOVING IN PARALLEL ELECTRIC AND MAGNETIC FIELDS. Kukanov, A. B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 6, 683-688(1974). (In Russian).

The problem of the radiation of point charged particles moving in parallel, constant, and homogeneous electric and magnetic fields was examined. An analytical expression was found for the total radiation energy with consideration of the polarization effect. The particular case of radiation for movement in a constant and homogeneous electric field was examined. (tr-auth)

16063 MOTION OF AN ELECTRON IN CONSTANT CROSSED ELECTRIC AND MAGNETIC FIELDS WITH RADIATION FRICTION. Voloshchenko, A. M. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 6, 699-703(1974). (In Russian).

Expressions were obtained for the 4-velocity and trajectory of an electron with consideration of the radiation friction during its movement in mutually perpendicular and equal in magnitude electric and magnetic fields. It was shown that the solution found differs from the exact solution of the Lorentz-Dirac equation by a value less than the quantum errors. (tr-auth)

16064 INTEGRATION BY TRAJECTORIES IN THE PROBLEM OF AN ELECTRON AND A RANDOM FIELD. Bonch-Bruevich, V. L.; Mironov, A. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 6, 723-729(1974). (In Russian).

The problem of the electron in a random field was examined by the Feynman continual integration method. The areas of applicability of the different approximations were explained. The Green function and the density of states with quantum errors were calculated. (tr-auth)

16065 FRICTION AND DISSIPATIVE PHENOMENA IN QUANTUM MECHANICS. Kostin, M. D. (Princeton Univ., NJ). J. Stat. Phys.; 12: No. 2, 145-151(Feb 1975).

Frictional and dissipative terms of the Schroedinger equation are studied. A proof is given showing that the frictional term of the Schroedinger–Langevin equation causes the quantum system to lose energy. General expressions are derived for the frictional term of the Schroedinger equation. (auth)

16066 ZITTERBEWEGUNG OF THE NEW POSITIVE-ENERGY PARTICLE. Dirac, P. A. M. (Florida State Univ., Tallahassee). pp 354-364 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

Recent developments of the new wave equation (delta/delta x_0 + alpha/sub r/ delta/delta x/sub r/ + beta) g psi equals 0 are discussed. One has a particle of a mass 1 with some internal motion and satisfying the usual de Broglie equation for all values of the internal variables. One finds the given equation is really a relativistic equation. (JFP)

16067 EQUIVALENCE OF THE TRANSFORM TECHNIQUE AND THE REPLICATION PROPERTY METHOD. Bienski, T.; Duracz, T.; Zelazny, R. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 20: No. 3, 281-289(1975).

The equivalence between two methods of solving the linear transport equation in spherical symmetry—the transform technique and the replication property method, is shown. The calculations were carried out for the one-group case using the Green function. The extension of the transform technique to the multigroup case is also given. (auth)

16068 WIGNER DISTRIBUTION FOR EIGENVALUES OF ½ h SPIN OPERATOR COMPONENTS. Gachechiladze, T. G.; Kirtadze, G. Sh. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 77: No. 2, 349-352(Feb 1975). (In Russian).

The derivation of the formula of joint distribution for eigenvalues of ½ h spin operator components is given; the extremum property of this distribution is proved. (auth)

16069 QUASI-DEGENERATE RAYLEIGH-SCHROEDINGER PERTURBATION THEORY WITH HERMITEAN MODEL HAMILTONIAN. Kvasnicka, V.; Holubec, A. (Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia)). Chem. Phys. Lett.; 32: No. 3, 489-492(1 May 1975).

A method for the construction of the hermitean model hamiltonian in the framework of the quasi-degenerate Rayleigh-Schrödinger perturbation theory is suggested. The approach of a model hamiltonian is based on the assumption that if it is diagonalized in a chosen finite-dimensional model space it will yield eigenvalues of the original hamiltonian in the entire Hilbert space. For a unitary operator transforming the unperturbed state vectors onto the perturbed state vectors, and a model-interaction operator, the perturbation-expansion formulas are developed. (auth)

16070 QUASI-LOCAL OBSERVABLES AND THE PROBLEM OF MEASUREMENT IN QUANTUM MECHANICS. Frigerio, A. (Milan Univ. (Italy). Istituto di Fisica). Ann. Inst. Henri Poincare, Sect. A.; 21: No. 3, 259-270(1974).

In the framework of infinite quantum systems, the possibility that interference terms vanish for t → infinite for all quasilocal observables is discussed. It is shown that this is possible even if the measuring apparatus that interacts with the objects is only a finite subsystem of the infinite (interacting) system. The intensive observables of the infinite system are not altered. Unfortunately approach to a unique equilibrium state is very likely to happen. A particular model for which all interference terms decrease faster than the differences between the expectation values in different states is studied. (FR)

16071 DETAILED BALANCE AND THE QUANTUM-MECHANICAL FOKKER-PLANCK EQUATIONS. Carmichael, H. J.; Walls, D. F. (Waikato Univ., Hamilton (New Zealand)). Phys. Lett., A; 53: No. 1, 11-13(19 May 1975).

Agarwal's definition of detailed balance for open quantum Markoffian systems in terms of two-time correlation functions is adopted as the appropriate formal generalisation of the classical concept to fully quantum-mechanical systems. This form for detailed balance is discussed in contrast to that resulting from the literal interpretation of quantum-mechanical Fokker-Planck equations. It is suggested that the two correspond in the classical limit. (auth)

16072 COMPUTER-DRAWN TRAJECTORIES OF PARTICLES IN MUTUAL AND EXTERNAL FIELDS—AN APPLICATION OF COMPUTERS IN UNIVERSITY PHYSICS TEACHING. Brandt, S. (Gesamthochschule Siegen (F. R. Germany). Abteilung fuer Physik); Schneider, H. (Heidelberg Univ. (F. R. Germany). Inst. fuer Hochenergiephysik). Comput. Phys. Commun.; 9: No. 4, 205-220(Apr 1975).

A software system is described which allows the simulation of a large variety of physics phenomena in the computer and the output of results in graphical form. It is designed for interactive use by a class of students working on display terminals. Great care is taken to design the simulation and the display part of the program as flexible as possible. Several examples of simulation are presented and future extensions of the method are discussed. (auth)

16073 REMARKS CONCERNING NAMBU'S GENERALIZED MECHANICS. Bayen, F.; Flato, M. (Physique-Mathématique, Collège de France, Paris 5, France). Phys. Rev. D 11: No. 10, 3049-3053 (15 May 1975).

Hamiltonian embedding is proposed for Nambu's new mechanical equations. This embedding is studied in classical and quantized versions, utilizing Dirac's singular formalism. Nambu's canonical transformations are then compared with those of the embedding Hamiltonian. (auth)

16074 LORENTZ-INVARIANT NEWTONIAN MECHANICS FOR THREE OR MORE PARTICLES. Jordan, T.F. (Department of Physics, University of Minnesota, Duluth, Duluth, Minnesota 55812). Phys. Rev. D 11: No. 10, 3035-3036 (15 May 1975).

Lorentz-invariant Newtonian equations of motion for three or more interacting particles can be constructed just as for two by assuming that the center-of-mass acceleration is zero when the center-of-mass velocity is zero. But two-particle systems are not obtained from a larger system of this kind when the other particles are widely separated in space. The same is true if the total relativistic kinematic particle momentum and its time derivative are used in place of the center-of-mass velocity and acceleration. The assumption that the center-of-mass acceleration is zero when the center-of-mass velocity is zero does not hold, in particular, for parity-conserving forces for three or more identical particles as it does for two. (auth)

16075 MOST-GENERAL MINIMALITY-PRESERVING HAMILTONIAN. Stoler, D. (Department of Physics, Polytechnic Institute of New York, Brooklyn, New York 11201). Phys. Rev. D 11: No. 10, 3033-3034 (15 May 1975).

This paper is concerned with Hamiltonians that preserve the minimum value of the uncertainty product. Using the method of time-dependent unitary transformations, we derive the most general such Hamiltonian. (auth)

16076 LORENTZ-INVARIANT NEWTONIAN MECHANICS FOR TWO PARTICLES. Jordan, T.F. (Department of Physics, University of Minnesota–Duluth, Duluth, Minnesota 55812). Phys. Rev. D 11: No. 10, 2807-2815 (15 May 1975).

Many ordinary Newtonian equations of motion in the center-of-mass frame can be made into Lorentz-invariant equations valid in all inertial frames. This is shown by outlining a construction of Poincaré-invariant Newtonian equations of motion, using global Lorentz transformations, starting with the assumption that at zero center-of-mass velocity the center-of-mass acceleration is zero, and the relative acceleration is specified as a function of the relative position and relative velocity, subject to some weak conditions. The only remarkable condition is a limit on repulsive forces, needed to keep the transformed center-of-mass velocity from being zero. This is generally satisfied up to energies comparable with the rest-mass energy. For Coulomb forces, it fails for higher energies, when the particles get closer than the classical electron radius and violate the uncertainty principle. (auth)

16077 LARMOR FORMULA IN CURVED SPACES. Villarroel, D. (Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile). Phys. Rev. D 11: No. 10, 2733-2739 (15 May 1975).

The energy-momentum tensor of the field produced by an electron with arbitrary movement in a curved space contains a tensor $T_{\mu\nu'}$ with the following properties: (i) vanishing covariant divergence, (ii) null flux across the cones that come out from the world line of the electron, and (iii) positive definite diagonal elements of $T_{\mu\nu'}$. These properties make it possible to express the differential conservation law in an integral form over a two-dimensional surface contained in the cone with apex in a fixed point of the world line of the electron. This integral gives a measure of the energy irreversibly emitted by the electron associated to the tensor $T_{\mu\nu'}$. The corresponding rate of radiation is given by $(\frac{2}{3})$ $\times e^2 z^{2\cdots 2}$ where $z^{\cdot 2}$ is the square of the covariant acceleration. (auth)

16078 BOUND AND EMITTED ANGULAR MOMENTA OF A CLASSICAL ACCELERATED POINT CHARGE. López, C.A.; Villarroel, D. (Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile). Phys. Rev. D 11: No. 10, 2724-2732 (15 May 1975).

It is shown that the angular momentum tensor of the retarded Liénard-Wiechert field of a classical point charge may be covariantly split into two parts separately conserved off the world line of the particle. These parts are identified without ambiguity as the angular momentum radiated by the charge and the angular momentum that remains bound to it. The bound and emitted angular momenta are shown to have similar properties to the corresponding energy-momentum quantities. In particular, the bound angular momentum is found to be also a state function of the charge. The equation of angular momentum balance is shown to be consistent with the Lorentz-Dirac equation of motion, and the source of the "intrinsic" (origin-independent) angular momentum emitted by a *nonspinning* point charge is identified. Finally, separate sources on the world line for both parts are found. (auth)

16079 TRANSMISSION THROUGH A REAL Eckart-Epstein POTENTIAL BARRIER TREATED BY MEANS OF CERTAIN PHASE-INTEGRAL APPROXIMATIONS. Karlsson, F. (Institute of Theoretical Physics, University of Uppsala, Uppsala, Sweden). Phys. Rev. D 11: No. 8, 2120-2123 (15 Apr 1975).

Formulas for the transmission and reflection coefficients for particle transmission through a real potential barrier were given some years ago by Fröman and Fröman in an explicit and general form, valid for any convenient order of certain phase-integral approximations. To illuminate the great accuracy of those formulas, the relative errors of the transmission and reflection coefficients for a real Eckart-Epstein potential barrier are calculated and graphically displayed up to the eleventh order. It is pointed out that the transmission coefficient recently obtained by Wald and Lu, by means of an extension of the method of Miller and Good to the next order of approximation, yields numerical results essentially equivalent to those obtained from the next lowest order of the Fröman and Fröman formula. Being explicitly given and containing no divergences, the latter formula is, however, analytically much simpler. (auth)

Quantum Field Theories

Refer also to abstract 15451, 15557, 15595, 15611, 15636, 15650, 15656, 15702, 15706, 15708, 15724, 15948, and 16185–16187.

16080 (CNRS-CPT-75-P-691) THE CLASSICAL EQUATIONS OF QUANTUM FIELD THEORY. Chadam, J. M. (Centre National de la Recherche Scientifique, 13- Marseille (France). Centre de Physique Theorique). Jan 1975. 12p. INIS.

A short, noncalculational statement is given of the current status of the existence, decay, and scattering problems for the classical (one-particle) nonlinear partial differential equations suggested by quantum field theory. (auth)

16081 (COO-1545-159) FERMION NUMBER CONSERVATION IN SUPERSYMMETRIC LAGRANGIANS. Mainland, G. B.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1975. 10p. (CONF-750636-1). Dep. NTIS $4.00.

From 5th international conference on neutrino science; Balaton, Hungary (16 Jun 1975).

The two known methods for introducing a conserved fermion number into supersymmetric models are discussed. Gauge models are presented in which masses can be introduced via spontaneous symmetry breaking while maintaining a conserved fermion number that does not require bosons to carry fermion number. (auth)

16082 (DESY-75/12) RENORMALIZATION PROBLEM IN NONRENORMALIZABLE MASSLESS PHI^4 THEORY. Symanzik, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). May 1975. 46p. Dep. NTIS (US Sales Only) $5.50.

Nonrenormalizable massless Φ^4 theory is made finite by regularization via higher derivatives in the kinetic part of the Lagrangean. The theory is shown to remain finite in the infinite cutoff limit if certain integrals over functions of one variable, with computable Taylor expansion at the origin, are finite. The values of these integrals are the only unknowns in the double series in powers of g and $g^{2/\epsilon}$ obtained for the Green's functions

in massless $(\Phi^4)_{4+\epsilon}$ with generic ϵ. For $\epsilon = 1$ and $\epsilon = 2$, these series reduce to double series in powers of g and in g. The problems of extension to $(\Phi^4)_{4+\epsilon}$ with mass, of causality and unitarity, of the relation to the BPHZ formalism, and of the indeterminacy of the result are discussed. (auth)

16083 QUANTUM ELECTRODYNAMIC AND SEMICLASSICAL INTERFERENCE EFFECTS IN SPONTANEOUS RADIATION. Herman, R. M. (Pennsylvania State Univ., University Park); Grotch, H.; Kornblith, R.; Eberly, J. H. Phys. Rev., A.; 11: No. 4, 1389-1396(Apr 1975).

The theory of spontaneous decay is studied using both quantum electrodynamics (QED) and semiclassical theories of radiation. There are qualitative differences between the theories in the prediction of interference phenomena. In QED, systems which were excited with pulsed laser light do not exhibit quantum interference effects associated with lower state splittings. On the other hand, semiclassical treatments of spontaneous decay do indicate the existence of interference effects not present in QED. In addition to this, differences are found between the predictions of fluorescence intensity in the presence of lower-state level crossings under continuous excitation. (auth)

16084 STATIONARY-TO-STATIONARY SOLUTIONS IN RELATIVITY THEORY. Sackfield, A. (Trent Polytechnic, Nottingham, Eng.). J. Phys., A (London); 8: No. 4, 506-507 (Apr 1975).

Stationary axially symmetric solutions claimed to be original by Kloster, Som and Das (J. Math. Phys.; 15: 1096 (1974)) are in fact known. A technique for derivation of the class of solutions is given. (auth)

16085 CAUSALITY AND INDEFINITENESS OF CHARGE IN SPIN 3/2 FIELD THEORIES. Prabhakaran, J.; Seetharaman, M.; Mathews, P. M. (Univ. of Madras). J. Phys., A (London); 8: No. 4, 560-565(Apr 1975).

The possibility of retaining causality of propagation of classical spin $\frac{3}{2}$ fields in the presence of an external electromagnetic interaction is investigated. It is shown that in the case of the mixed spin $\frac{3}{2}$-spin $\frac{1}{2}$ theory of Bhabha (Phil. Mag.; 43: 33-47 (1952)) and Gupta (Proc. R. Soc.; A222: 118 to 27 (1954)), causality in the interacting situation may be retained by giving up the positive definiteness of the free total charge and making an appropriate choice of the arbitrary parameters appearing in the Bhabba-Gupta Lagrangian. It is demonstrated that the causal spin $\frac{3}{2}$ equation proposed recently by Fisk and Tait (J. Phys. A. Math. Nucl. Gen.; 6: 383-92 (1973)) also shares the same feature, namely the indefiniteness of the free total charge. (auth)

16086 TRANSFORMATION GROUPOID OF LORENTZ INVARIANT SPACE. Lloyd, P. (Monash Univ., Clayton, Australia). J. Phys., A (London); 8: No. 4, 459-472(Apr 1975).

In a relativistic description of nature, physics may be seen as the transformation of events from one space-like surface in Minkowski space to another such space-like surface. An abstract algebra is formulated which characterizes such transformations in much the same sort of way as the algebra of the rotation group characterizes rotational transformations. Both quantum field theory and the classical theory of contact transformations are representations of this algebra. Hence from this viewpoint quantum field theory becomes the group theoretical problem of constructing unitary irreducible representations of the algebra. (auth)

16087 CONFORMAL COVARIANT OPERATOR PRODUCT EXPANSION (OPE) OF TWO SPIN 1/2 FIELDS. Dobrev, V. K.; Hristova, E. H.; Petkova, V. B.; Stamenov, D. B. (Inst. for Nuclear Research and Nuclear Energy, Sofia). Bulg. J. Phys.; 1: No. 1, 42-57(1974).

A global conformal invariant operator expansion for the product of two Dirac fields is obtained. The manifest conformal covariant formulation of local field theory is used. The basis needed consists of six kinds of tensor fields: tensors of type (n/2, n/2) and $((n+2)/2, n/2) \oplus (n/2, (n+2)/2)$ (accounting γ_{5}- and P-parity). Canonical and noncanonical dimensions are discussed separately. Some two- and three-point functions are written down. The connection between the expansion and the corresponding three-point functions is illustrated. (auth)

16088 BARGMANN TRANSFORMATION OF RELATIVISTIC GREEN'S FUNCTIONS. Lukierska, K. (Univ., Wroclaw). Acta Phys. Pol., Ser.; B6: No. 2, 273-284(1975).

An investigation is given of Bargmann transformations of free relativistic Green's functions. The equivalence of two types of triplets on the space of entire analytic functions is proven. Explicit analytic expression for the Bargmann transformation of free field propagators in one-dimensional case with any value of the mass parameter is presented. In four-dimensional Minkowski space Bargmann transformations are derived for massless particles. In the case of massive particles it was shown that the Bargmann transformations can be obtained in the form of power series representing entire functions. An analytic representation of the unitarity and causality conditions is given, and the invariance of the growth and type with respect to Poincaré transformations is shown. (auth)

16089 CONSTRUCTIVE FIELD THEORY: INTRODUCTION TO THE PROBLEMS. Wightman, A. S. (Princeton Univ., NJ). pp 1-85 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

A review is given of constructive field theory with restriction to super-renormalizable theories in two dimensional space-time. (JFP)

16090 P(phi)$_2$ MODEL. Rosen, L. (Princeton Univ., NJ). pp 86-107 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

In the treatment of the P(phi)$_2$ model describing self-interacting massive scalar bosons in two space–time dimensions, no attempt is made at comprehensiveness, but some aspects of the construction which illustrate the techniques used are treated. (JFP)

16091 YUKAWA QUANTUM FIELD THEORY IN TWO SPACE–TIME DIMENSIONS. Schrader, R. (Harvard Univ., Cambridge, MA). pp 108-119 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The review of recent progress on the Yukawa model in two space–time dimensions covers the locally correct Hamiltonian, fields, field equations, and currents, and the infinite volume limit. (JFP)

16092 PERTURBATION THEORY AND COUPLING CONSTANT ANALYTICITY IN TWO-DIMENSIONAL FIELD THEORIES. Simon, B. (Princeton Univ., NJ). pp 120-144 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

Conjectural material and results over a year old are presented in the discussion of perturbation theory and coupling constant analyticity in two-dimensional field theories. General properties of perturbation series are discussed rather than questions of field theory. The question is interesting for two reasons: First, one would like to understand why perturbation theory is such a good guide (to show that perturbation theory determines the theory in some way). Secondly, one hopes to prove that some or all of the theories are nontrivial. (JFP)

16093 CONSTRUCTIVE FIELD THEORY: PHASE II. Jaffe, A. (Harvard Univ., Cambridge, MA). pp 145-156 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The question of how an interacting field model reacts to perturbations by an external source is discussed. The external source problem is described, then phase II, expansion in graphs, a bound on graphs, the inductive construction, and phase space localization are discussed. (JFP)

16094 GAUGE INVARIANT SPINOR THEORIES AND THE GRAVITATIONAL FIELD. Durr, H. P. (Max-Planck-Institut, Munich). pp 411-421 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

The requirement of gauge symmetries for the theory as a possibility of inferring mass zero solutions is discussed. The gauge approach has the advantage that it does not only provide a handle to enforce mass zero particles with nonzero spin but introduces these particles with the correct coupling (minimum coupling) which automatically contains the nonparticle contributions as Coulomb interaction and Newtonian gravitational interaction respectively. The gauge symmetries used are defined as continuous symmetry transformation in which the Lie parameters are arbitrary functions of space and time. (JFP)

16095 PARTICLES AS NORMAL MODES OF A GAUGE FIELD THEORY. Cooper, F. (Yeshiva Univ., New York); Chodos, A. pp 441-456 of Fundamental Interactions in Physics and Astrophysics. Iverson, G. (ed.). New York; Plenum Publishing Corp. (1973).

From conference on fundamental interactions at high energy; Coral Gables, Florida, USA (26 Jan 1972). See CONF-720114-.

It is shown how one can describe the physical properties of the hadrons, such as the mass spectrum and electromagnetic form factors by considering the hadrons to be normal modes of an underlying field theory possessing gauge invariance of the second kind. (JFP)

16096 INTRODUCTION OF THE RELATIVITY PRINCIPLE INTO DENMARK. Pedersen, O. (Aarhus Univ., Denmark). Fys. Tidsskr.; 72: No. 2-3, 124-134(1974). (In Danish).

After its publication in 1905 the relativity theory had to face much opposition before it was accepted by physicists throughout the world. The controversy produced a considerable literature, recently subjected to historical analysis in Tonnelat's: "Histoire du principe de relativité" (Paris 1971). This book forms the introduction to the more restricted treatment of the history of the theory in Denmark presented. (ADN)

16097 APPROXIMATE METHODS OF THE QUANTUM FIELD THEORY AND THE CONCEPTION OF STRAIGHT-LINE PATHS AT HIGH ENERGIES. Kuleshov, S. P.; Matveev, V. A.; Sisakyan, A. N.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Bulg. J. Phys.; 1: No. 3, 223-232(1974). (In Russian).

A number of approximate methods for calculation of the functional integrals which can be used to find the Green functions and the scattering amplitudes in quantum field theory are formulated. The operator method of solving the quasipotential equations is developed. It is shown that in high energies these methods are the different versions of the conception of straight-line paths. (auth)

16098 TRANSLATION INVARIANCE OF QUANTUM FIELD THEORY IN MOMENTUM SPACE WITH CONSTANT CURVATURE. Donkov, A. D.; Kadyshevskii, V. G.; Mateev, M. D.; Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Bulg. J. Phys.; 1: No. 2, 150-160(1974). (In Russian).

A self-consistent formulation of the translation invariance condition in quantum field theory with De Sitter momentum space is given. (auth)

16099 RELATIVISTIC EIKONAL PHYSICS. Dittrich, W. (Univ., Tuebingen, Ger.). Fortschr. Phys.; 22: No. 10, 539-574 (1974).

It is shown how field theory models (neutral scalar field theory and quantum electrodynamics) can describe phenomena which become dominant in the high energy region of various scattering processes. (JFP)

16100 SHORT DISTANCE SCALE INVARIANCE, HIGH ENERGY PROCESSES AND ELEMENTARY PARTICLES. Efremov, A. V.; Ginzburg, I. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Phys.; 22: No. 10, 575-609(1974).

Within the framework of quantum field theory (QFT) with the Yukawa type of interactions of baryons and mesons a method is proposed which allows one to take into account the effects of short distance scale invariance in observable processes on the mass shell. In this theory the scale invariance is equivalent to the finite renormalization of coupling constants. The method is based on the investigation of asymptotics of diagrams and on the summation of all logarithmic terms of all diagrams. The general picture of high energy processes is in qualitative agreement with the present experimental situation, however, it manifests some peculiarities: For the scattering at small angles one obtains the modified Regge picture with fixed branch points of the $\sqrt{j-j_0}$ type in addition to the Regge poles. One of these branch points could be a good candidate for the Pomeranchuk singularity, the others are useful for some more delicate details of the scattering (e.g., polarization in the π N-charge exchange). The large angle scattering cross section decreases as a power of energy. The Bjorken scaling in the deep inelastic ep-scattering is not a direct effect of scale invariance and can be broken due to the factor $(-q^2)^{\dagger}\gamma$. For the inclusive processes the modified Regge picture is obtained. The large transverse momentum distribution decreases as a power of $q_{\perp}$. A weak power growth of multiplicity and logarithmic growth of average transverse momenta are possible. In addition to the composite, reggeized particles there are some elementary mesons and nucleons which explain the peculiarities of the reactions with their exchange. (auth)

16101 LOCALITY AND CAUSALITY CONDITIONS IN QUANTUM FIELD THEORY ON THE DE SITTER MOMENTUM SPACE. Donkov, A. D.; Kadyshevskii, V. G.; Mateev, M. D.; Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Bulg. J. Phys.; 1: No. 3, 233-248(1974). (In Russian).

Configuration ξ-space canonically conjugated to DeSitter momentum space is introduced. Generalized locality and causality conditions for the current operators defined in curved p-space are formulated in ξ-representation. (auth)

16102 LAGRANGIAN FORMALISM FOR FINITE COMPONENT FIELDS WITHOUT SUBSIDIARY CONDITIONS. Zaikov, R. P. (Higher Pedagogical Inst., Shumen, Bulgaria). Bulg. J. Phys.; 1: No. 3, 249-262(1974). (In Russian).

Usually in quantization of tensor and spinor fields with arbitrary spin, certain subsidiary conditions are imposed, which ensure the spectral conditions. A Lagrangian formalism is proposed which yields a positive energy spectrum without imposing subsidiary conditions. To this end essentially the projection operators Π_s are used. The explicit form of these operators is given for tensor fields and for spinor fields. By means of these operators one constructs fields with definite spin, e.g., in the case of tensor field one has $V_s(\chi) = \Pi_s\Phi(\chi)$ ($s = 0, 1, \ldots, n$). The spectral condition is satisfied without exclusion of the lower spins. This could be seen from equations giving the energy-momentum four-vector. Other equations imply that one has a local theory, and that the formalism is canonical. Heisenberg equations of these fields are given. Interactions given by the Lagrangians are considered which imply that field equations with different spin, couple. The propagators of the tensor and the spinor fields are obtained. (auth)

16103 THEORY OF THE ELECTROMAGNETIC FIELD. Cook, D. M. Englewood Cliffs, NJ; Prentice-Hall, Inc. (1975). 526p. $14.95.

Aspects related to the concepts of charge and current are considered along with the effect of the electromagnetic field on general charge distributions, the electrical field produced by static charges, the magnetic induction field produced by steady currents, the electromagnetic field produced by time-dependent charge distributions, plane electromagnetic waves in vacuum, problems of potential theory, and time-dependent fields in the presence of matter. The properties of matter are examined, giving attention to dielectric polarization, magnetization, and conduction. Other topics discussed are related to plane electromagnetic waves in linear matter, radiation from prescribed sources in vacuum, and the relativistic formulation of Maxwell's equations. (Int. Aerosp. Abstr.)

16104 INFINITE COMPONENT FIELD THEORY OF INTERACTING RELATIVISTIC STRINGS AND DUAL THEORY. Cremmer, E.; Gervais, J. L. (Ecole Normale Superieure, 75 - Paris (France)). Nucl. Phys., B; 90: No. 3, 410-460(19 May 1975).

Using light-cone quantization, the multistring formalism is unambiguously established from operator formalism by introducing an infinite component field Φ which is a key vector in the Fock space of transverse oscillators and the Φ^3 interaction corresponding to the dual vertex of ADDF. A functional multistring field is naturally obtained as the component of Φ in the basis $\{x\}$ where the string operator X is diagonal. It differs from Kaku and Kikkawa's one by an infinite phase factor which does not allow them to take the value of the intercept into account. In this way, the functional approach to the dual amplitude with a well-defined functional measure is recovered which could not have been guessed a priori, and which is determined from the previously established expression of the vertex in the $\{x\}$ basis. The scattering amplitudes are deduced from field-theory asymptotic conditions and perturbation theory. On-shell amplitudes are shown to agree with the form proposed by Mandelstam integrated over time differences instead of Koba-Nielsen variables. Two prescriptions for off-shell amplitudes are discussed. One of them agrees with Mandelstam's while the other one is deduced from reduction formulae. The latter prescription is time-translation invariant whereas the former is not. For the four-string amplitude, it is proved that the part of the integrand which does not depend on the external states is at 26 space-time dimensions, precisely the one required to change variables from time differences to Koba-Nielsen variables. This allows the unambiguous determination of the Φ^4 term which is needed to reproduce the complete tree dual amplitude. (auth)

16105 THE ABELIAN HIGGS MODEL IN THE LANDAU GAUGE. Clark, T. E. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Nucl. Phys., B; 90: No. 3, 484-500(19 May 1975).

Use is made of the modified BPHZ renormalization program proposed by Lowenstein and Zimmermann for theories with massless propagators to formulate a meaningful Lagrangian for the Abelian Higgs model in the Landau gauge directly. The current

Ward-Takahashi identity is obtained and applied to the formal unitarity relations to make apparent the physical content of the Higgs phenomenon. A unitary S-matrix is constructed from these considerations. (auth)

16106 LATTICE GAUGE THEORIES AND MOTION IN GROUP SPACE. Canning, G. P. (Niels Bohr Institutet, Copenhagen (Denmark)); Foerster, D. (Technische Univ. Clausthal, Clausthal-Zellerfeld (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., B; 91: No. 1, 151-159(26 May 1975).

The SU(2) lattice gauge theory of Kogut and Susskind is extended to a general non-Abelian gauge group. At the Lagrangian level, the theory is found to be related to the motion of a point in group space. Such a system is then quantized using the natural geometric structure of group parameter space, and the results are applied to find the Hamiltonian for the general lattice gauge theory. The large N behaviour of the theory is also discussed. (auth)

16107 SELECTION RULES IN A UNIFIED GAUGE MODEL OF LEPTONS AND HADRONS. Franklin, W. R. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Nucl. Phys., B; 91: No. 1, 160-178(26 May 1975).

Decay modes and lifetimes of quarks, vector mesons and protons are determined for the unified model of leptons and hadrons recently proposed by Pati and Salam. It is found that while both the quarks and gauge mesons decay too rapidly to be observed, protons will be comfortably stable against decay into leptons, consistent with earlier estimates and existing experimental evidence. It is of special interest that while quarks may not be directly observable, their presence may be verified owing to the uniqueness of their preferred decay into quite a large number of pions. An anomalous lepton-hadron scattering process whose occurrence would imply the presence of exotic SU(4) gluons carrying both baryon and lepton number is also discussed. (auth)

16108 CONNECTIONS AMONG SOME INTEGRAL REPRESENTATIONS FOR THE VERTEX FUNCTION. Ullberg, M. (Lund Univ. (Sweden)). Nucl. Phys., B; 90: No. 2, 313-335 (12 May 1975).

The "axiomatic" domain of analyticity of the vertex function has formed the starting point for derivations of several different integral representations for this function. Källén and Toll have derived representation formulas for the vertex function by means of the Bergman-Weil integral. Later, Andersson has derived dispersion relations for the absorptive part, using the Cauchy integral. In this paper an alternative Bergman-Weil representation for the vertex function is presented. This representation formula is a generalization of those of Andersson and is potentially more useful than the formulas of Källén and Toll. Bergman-Weil representations, very similar to Andersson's representation formulas, are also given for the absorptive part of the vertex function. The connections among all the representation formulas mentioned above are investigated. (auth)

16109 S-CHANNEL STRUCTURE OF THE TWO-REGGEON CUT. DeGrand, T. A. (Geneva Univ. (Switzerland). Inst. de Physique Theorique); DeTar, C. E. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 90: No. 2, 189-202(12 May 1975).

The three contributions to the s-channel discontinuity of the two-reggeon cut (called "diffractive", "absorbed multiperipheral" and "polyperipheral") are evaluated in the limit $s \to \infty$ in two contrasting models: a simple dual resonance model for the cut, and the Mandelstam graph. The models differ in the relative importance of the three contributions, contrary to prevailing belief. The analysis presented here provides a link between general investigations of the asymptotic singularity structure of Regge-behaved amplitudes and the s-channel structure of reggeon diagrams. (auth)

16110 TRANSITION ELECTROMAGNETIC FIELDS IN PARTICLE PHYSICS. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 90: No. 2, 203-220(12 May 1975).

A computation of one-loop effective potentials is presented for elementary systems placed in a strong magnetic or a laser-produced electromagnetic environment. This permits a determination in principle of a hierarchy of transition field strengths, for which the systems concerned may (for appropriate values of the parameters in the theory) make transitions from a spontaneously broken asymmetric phase to one of restored symmetry. (auth)

16111 ON THE ABSORPTION OF NEUTRINOS IN COSMIC SPACE. Krat, V. A.; Gerlovin, I. L. (The Pulkovo Astronomical Observatory, Leningrad, USSR). Astrophys. Space Sci.; 34: No. 2, L11-L12(May 1975).

In the fundamental field theory (FFT) (Gerlovin, 1973) dealing with a definite structure of vacuum the concept of vacuum assumes a new aspect. It enables the properties of gravitational field to be explained standing on a unique point of view (Krat and Gerlovin, 1974). The vacuum structure consisting of an enormous sample (about 10^{39} cm^{-3}) of elementary vacuum particles (EVP) can be directly observed only in the process of vacuum excitation. (auth)

16112 REMARKS ON SPONTANEOUS MASS GENERATION. Frishman, Y.; Römer, H.; Yankielowicz, S. (Weizmann Institute of Science, Rehovot, Israel). Phys. Rev. D 11: No. 10, 3040-3045 (15 May 1975).

Spontaneous mass generation is discussed. General arguments are given for the case of two zeros of β, implying no mass generation between the zeros. This is used to question the $1/N$ expansion in a four-fermion two-dimensional model. General comments regarding dynamical mass and effective potential are also included. (auth)

16113 CALLAN-SYMANZIK EQUATION AND THE VAN HOVE-RUIJGROK MODEL. Wang, M. (Center for Theoretical Studies, University of Miami, Coral Gables, Florida 33124). Phys. Rev. D 11: No. 10, 3046-3048 (15 May 1975).

Dimensional regularization is used to derive the coefficients of the Callan-Symanzik equation in the Van Hove-Ruijgrok model. The properties of this model are then discussed. In particular, Wilson's conjecture is demonstrated. (auth)

16114 CURRENT-FIELD IDENTITIES OF VECTOR MESONS. Kyriakopoulos, E. (Nuclear Research Center Demokritos, Aghia Paraskevi, Attikis, Greece). Phys. Rev. D 11: No. 10, 3037-3039 (15 May 1975).

A gauge-invariant Lagrangian, leading to a hadronic electromagnetic current which to order e is a linear combination of the vector mesons ρ^0, ϕ, and ω, is constructed when the vector mesons are described by an antisymmetric second-rank tensor field. (auth)

16115 SPONTANEOUS SYMMETRY BREAKING IN MASSLESS FIELD THEORIES. Banks, T. (Department of Physics and Astronomy, University of Tel-Aviv, Ramat-Aviv, Israel). Phys. Rev. D 11: No. 10, 2876-2879 (15 May 1975).

Spontaneous symmetry breakdown in massless field theories is studied with the aid of the renormalization group. We demonstrate the generality of the phenomenon of "dimensional transmutation" discovered by Coleman and Weinberg. We also show that spontaneous symmetry breaking cannot occur in infrared-stable massless field theories of the type studied in this paper. (auth)

16116 QUANTUM THEORY OF A NEUTRAL DIPOLE IN A RADIATION FIELD. Barone, S.R.; Narcowich, M.A. (Polytechnic Institute of New York, Long Island Center, Farmingdale, New York 11735). Phys. Rev. D 11: No. 10, 2880-2884 (15 May 1975).

A physical interpretation is given for the Heisenberg equations implied by the usual phenomenological Hamiltonian for a neutral, magnetic dipole in a radiation field. If the Heisenberg equations that characterize the quantum description are to be formally the same as their classical counterparts, a distinction must be made between the canonical and orbital momenta, even for a neutral system. This leads to a novel interpretation of the spin-orbit energy and a reidentification of the electric polarizability of the system. The general ideas are illustrated by considering the exactly soluble special cases of a neutral magnetic dipole with a nonvanishing electric polarizability in uniform, static fields and in the field of a monochromatic, plane wave. A Lagrangian formalism corresponding to these ideas is also presented. (auth)

16117 NONPERTURBATIVE CORRECTIONS TO BOUND STATES OF THE QUASIPOTENTIAL EQUATION BY PADÉ APPROXIMANTS. Atkinson, D.A. (104 Violet Street, Pittsburg, Pennsylvania 15229); Crater, H.W. Phys. Rev. D 11: No. 10, 2885-2899 (15 May 1975).

A nonperturbative approach to the relativistic bound-state problem is tested in a simplified version of quantum electrodynamics. The approach used is based on applying Padé approximants to a perturbation series of quasipotentials derived from an inhomogeneous quasipotential equation. The resultant nonperturbative form of the quasipotential is used in solving the homogeneous quasipotential equation (relativistic Schrödinger equation). The size of the nonperturbative results of the Lamb shift is compared with that of the perturbative results. As with real quantum electrodynamics for point particles, this simplified model we use to test our approach gives complex energies if the coupling constant is larger than some critical value. The change of this critical value of the coupling constant which results from using a nonperturbative form of the potential is computed. (auth)

16118 ASYMPTOTIC SCALE INVARIANCE FOR PHYSICAL PROCESSES. Borenstein, J.M. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 10, 2900-2904 (15 May 1975).

By examining the Nakanishi parametric functions, certain on-mass-shell processes are shown to be asymptotically determined by short-distance structure, giving rise to a possible explanation for experimental behavior. (auth)

16119 FIXED-ANGLE SCATTERING IN QUANTUM FIELD THEORY. Callan, C.G. Jr.; Gross, D.J. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 10, 2905-2920 (15 May 1975).

We have examined the high-energy, fixed-angle behavior of exclusive scattering amplitudes in the context of renormalizable field theories. We find that renormalization-group techniques, asymptotic conformal invariance, and reasonable conjectures about the existence of the zero-mass limit of such theories allow one to understand simple power laws for fixed-angle scattering of the type proposed by Brodsky and Farrar and Matveev *et al.* Since our techniques rely on the existence of a smooth infrared limit of the underlying quantum field theory, they are unfortunately not powerful enough to discuss theories with vector mesons. Consequently, it remains moot whether the classical examples of asymptotically free theories really manifest simple fixed-angle scaling. (auth)

16120 SECOND-QUANTIZED NON-ABELIAN FIELD THEORY FOR HADRONS WITH QUARK CONFINEMENT AND SCALING DEEP-INELASTIC STRUCTURE FUNCTIONS. Blaha, S. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. D 11: No. 10, 2921-2931 (15 May 1975).

A four-dimensional second-quantized field theory with quarks bound by "colored" non-Abelian gluons is described which has the following properties: (1) the only physical particles are color singlets composed solely of quarks, (2) the deep-inelastic structure functions have Bjorken scaling, (3) gluon loops and Faddeev-Popov ghost loops are identically zero in any gauge, (4) Regge trajectories are apparently linear on a Chew-Frautschi plot, and (5) constituent motion within hadrons can be nonrelativistic. (auth)

16121 EXTENDED PARTICLES IN QUANTUM FIELD THEORIES. Gervais, J. (Laboratoire de Physique Theorique de l'Ecole Normale Superieure 75005 Paris, France); Sakita, B. Phys. Rev. D 11: No. 10, 2943-2945 (15 May 1975).

The method of collective coordinates developed in the study of strong-coupling theory is used for the quantization of the kink solution of a two-dimensional nonlinear field theory. The position of the kink is treated as a collective coordinate, which represents the position of a particle. It is separated from the rest of the coordinates, which represent the internal degrees of freedom of an extended particle. Two similar but different methods are presented; the one is nonrelativistic and suited for the weak-coupling limit, while the other is relativistic. (auth)

16122 INTERNAL SYMMETRY AND THE SEMICLASSICAL METHOD IN QUANTUM FIELD THEORY. Rajaraman, R.; Weinberg, E.J. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 10, 2950-2966 (15 May 1975).

We apply the methods of Dashen, Hasslacher, and Neveu to quantum field theories with continuous global symmetries. With a U(1) symmetry we show that it is possible to project out a subspace of fixed charge, and to reformulate the theory as one with internal symmetry, but with centrifugal terms arising from rotation in the internal-symmetry space; in the weak-coupling regime, static solutions of this equivalent problem determine the energies of the bound states. Within a particular model in one spatial dimension we demonstrate the existence of such bound states and examine the dependence of their energies upon the charge. The extension of the method to non-Abelian groups is illustrated with SU(2) examples. (auth)

16123 ELECTROMAGNETISM AS A STRONG INTERACTION. Halpern, M.B.; Siegel, W. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 11: No. 10, 2967-2976 (15 May 1975).

In gauge theories of strong, weak, and electromagnetic interactions, the fine-structure constant (α) is a lower bound on the strength of weak and strong couplings. This opens the possibility of physical systems wherein all fundamental couplings are large, and α is a low-energy phenomenon of the system (essentially a collective property of the strong interactions). We construct such a model. At present experimental energies, it agrees with standard (hadron-modified) electrodynamics, while revealing a strongly coupled photon in the extreme asymptotic region. (auth)

16124 SOLITON OPERATORS FOR THE QUANTIZED SINE-GORDON EQUATION. Mandelstam, S. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 11: No. 10, 3026-3030 (15 May 1975).

Operators for the creation and annihilation of quantum sine-Gordon solitons are constructed. The operators satisfy the anticommutation relations and field equations of the massive Thirring model. The results of Coleman are thus reestablished without the use of perturbation theory. It is hoped that the method is more generally applicable to a quantum-mechanical treatment of extended solutions of field theories. (auth)

16125 THREE-PARTICLE STRUCTURE OF ϕ^4 INTERACTIONS AND THE SCALING LIMIT. Glimm, J. (Rockefeller University, New York, New York 10021); Jaffe, A. Phys. Rev. D 11: No. 10, 2816-2827 (15 May 1975).

We show that the inverse propagator $\Gamma(x)$ and the proper self-energy part $\Pi(x)$ are positive for all $x \neq 0$. These results combined with some postulates on the sign or the decay of the vertex functions, in particular, on the decay rate for $\Gamma(x)$, yield the absence of three-particle bound states and the existence of the scaling (Gell-Mann, Low, Wilson) limit for the ϕ^4 interaction. (auth)

16126 SHORT-DISTANCE DOMINANCE OF VERTEX FUNCTIONS. Menotti, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 and Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 10, 2828-2838 (15 May 1975).

In order to calculate high-energy high-momentum-transfer processes for particles described by composite fields one needs to know some uniformity properties of the external-particle vertex function. We examine such a vertex function in a scalar theory in six dimensions in the case in which anomalous dimensions are realized. We start from the result that, in a certain class of renormalizable theories, the vertex function for three fundamental fields is dominated by short distances. This is used to prove that the convolution of the composite-particle vertex function with the direct and crossed renormalized skeleton graphs is consistent only if such a vertex function is also dominated by short distances. (auth)

16127 DYNAMICAL SYMMETRY BREAKING IN NON-ABELIAN GAUGE FIELD THEORIES. Tye, S.H.; Tomboulis, E. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Poggio, E.C. Phys. Rev. D 11: No. 10, 2839-2855 (15 May 1975).

The possibility of dynamically induced spontaneous symmetry breaking is investigated in a general non-Abelian gauge theory with fermions. We present arguments which demonstrate how an asymptotically free gauge theory with fermions can lead to massive vector mesons without the presence of canonical scalar fields. In particular, the asymptotic freedom of the theory is exploited in an investigation of the relevant Bethe-Salpeter equation beyond the conventional ladder approximation. Differences between the Abelian and the non-Abelian gauge theories are discussed. (auth)

16128 INFRARED SINGULARITIES AND MASSIVE FIELDS. Appelquist, T.; Carazzone, J. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 10, 2856-2861 (15 May 1975).

We examine some problems associated with the low-momentum behavior of gauge theories and other renormalizable field theories. Our main interest is in the infrared structure of unbroken non-Abelian gauge theories and how this is affected by the presence of other heavy fields coupled to the massless gauge fields. It is shown in the context of a simple model of gauge mesons coupled to massive fermions that the heavy fields decouple at low momenta except for their contribution to renormalization effects. This result is used to discuss the mass-shell structure of the fermion propagator. The decoupling theorem is then stated for a general renormalizable theory and applied to some interesting examples. One is a more general gauge theory which makes use of the Higgs mechanism and attempts to unify the elementary particle forces. Another is the connection of the linear and nonlinear σ models in the limit $m_\sigma \to \infty$. (auth)

16129 HOW TO SPLIT PARITY DOUBLETS. Biritz, H. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). Phys. Rev. D 11: No. 10, 2862-2869 (15 May 1975).

Manifest covariance of relativistic wave equations under parity can usually only be achieved by a doubling of the degrees of freedom. We show that for general wave equations this parity doubling has sometimes far from trivial consequences. As illustrated for a certain class of wave equations, such theories contain free parameters which can be used to split the parity doublets and even change their parities while still maintaining covariance under parity. (auth)

16130 GAUSSIAN PATH INTEGRALS. Papadopoulos, G.J. (Department of Applied Mathematics, University of Leeds, Leeds LS2 9JT, United Kingdom). Phys. Rev. D 11: No. 10, 2870-2875 (15 May 1975).

The path-integral method is employed systematically throughout for the derivation of the propagator associated with the most general form of a quadratic Lagrangian. The result is applied for the evaluation of the propagator of a constrained particle having a dissipative Lagrangian. (auth)

16131 HIGGS-TYPE LAGRANGIAN AND DUAL STRINGS. Arik, M.; Tanaka, K. (Department of Physics, The Ohio State

University, Columbus, Ohio 43210). Phys. Rev. D 11: No. 10, 2803-2806 (15 May 1975).

A nonlinear Born-Infeld type of Lagrangian which yields the Maxwell and Higgs Lagrangian in the weak limit and the dual string model in the strong limit is studied. In particular, it is argued that the limit in which the stringlike solution is obtained is a super-quantum-mechanical limit. The effect of the contributions which become zero in this limit is discussed, and an approximate vortex line solution is obtained. (auth)

16132 FOUR-FERMION INTERACTIONS AND SCALE INVARIANCE. Dashen, R.; Frishman, Y. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 10, 2781-2802 (15 May 1975).

Four-fermion interactions of the current-current type with U(n) symmetry, in one space and one time dimension, are investigated. It is shown that the equations of motion yield scale-invariant solutions only for two values of the coupling g_s of the SU(n) currents, namely $g_s = 0$ and $g_s = 4\pi / (n+1)$. This holds for any value of the coupling g_B of the U(1) currents. For the above two values of g_s and any g_B the theory is solved completely. Operator products of spinor fields are shown to be equal to c-number functions singular on the light cone times analytic bilocal operators expressed in terms of currents and free spinor fields. The currents are free for the above two values of g_s. The connection with the coupling as defined through four-point functions is discussed, and it turns out that the combination corresponding to SU(n) coupling is zero for both solutions. However, the solution for $g_s = 4\pi / (n + 1)$ exhibits nontrivial four-point functions also for $g_B = 0$. It is shown, in an expansion around $g_s = 0$, that there is only one Callan-Symanzik function β which depends only on g_s and that $g_s = 0$ is relevant to the ultraviolet limit of the $g_s > 0$ theories. When mass terms are introduced, this still holds in an infinite interval for g_B which is bounded below by a certain negative value and in which the mass term is soft. (auth)

16133 SCALE TRANSFORMATION AND MASSLESS LIMIT IN NEUTRAL-VECTOR FIELD THEORY. Kubo, R.; Takahashi, Y.; Yokoyama, K. (Research Institute for Theoretical Physics, Hiroshima University, Takehara, Hiroshima 725, Japan). Phys. Rev. D 11: No. 8, 2335-2339 (15 Apr 1975).

In a wide class of neutral-vector field theories, in which massive and massless fields are described in a unified way and a unique massless limit exists to quantum electrodynamics in covariant gauges, the commutability of the scale transformation and the massless limit is examined. It is shown that there occurs no anomaly with respect to the assignment for scale dimensions of relevant fields. The connection of scale transformation and gauge transformation is also discussed. (auth)

16134 GAUGE-INVARIANT CONTENT OF THE EFFECTIVE POTENTIAL. Frère, J.; Nicoletopoulos, P. (Faculté des Sciences, Université Libre de Bruxelles, Brussels, Belgium). Phys. Rev. D 11: No. 8, 2332-2334 (15 Apr 1975).

It is argued that within the class of manifestly covariant gauges the gauge dependence of the renormalized effective potential $V(\phi_c)$ in massless scalar electrodynamics can be absorbed into the dressed value $\bar{\phi}$ of $\phi_c = \langle 0|\phi|0\rangle$ to any order in the loop expansion; and use may be made of this fact to obtain the gauge-invariant content of Coleman-Weinberg-type stability conditions. (auth)

16135 FIXED REGGE SINGULARITY AND SMALL-DISTANCE BEHAVIOR IN RENORMALIZABLE FIELD THEORIES: A MODEL IN ϕ_6^3. Muzinich, I.J.; Tsao, H. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 8, 2203-2208 (15 Apr 1975).

We present a detailed analysis of the skeleton ladder graphs for ϕ_6^3 theory in six dimensions. The ladder graphs are dominated by an energy-independent branch point in the angular momentum plane reminiscent of similar results in ϕ^4 theory. This model then serves as a prototype for models in other exactly renormalizable field theories. These branch points are contained explicitly in the anomalous dimensions of the local operators that occur in the Wilson expansion. We contrast our results with some previous results for all internal particles of zero mass. A general renormalization-group-type argument is advanced to determine the conditions for which the complete theory would contain these fixed cuts. (auth)

16136 HIGH-ENERGY BEHAVIOR OF ϕ^3 THEORY IN SIX DIMENSIONS. Brown, R.W.; Gordon, L.B. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wong, T.F.; Young, B. Phys. Rev. D 11: No. 8, 2209-2218 (15 Apr 1975).

We examine the high-energy behavior of scattering amplitudes in an asymptotically free field theory, ϕ^3 theory in six dimensions. It is seen that, as in non-Abelian gauge theories, the lack of transverse-momentum cutoff gives rise to a $\ln^2 s$ expansion. Within this leading-logarithm approximation, ladder diagrams dominate in each order and their series corresponds to a fixed Regge cut. The nonleading logarithmic corrections and a (truss) bridge between our results and those for ϕ^4 in four dimensions are discussed as is the possible change in the Regge singularity if a different summation is followed. (auth)

16137 HIGH-ENERGY SCATTERING OF SPINNING PARTICLES BY EXTERNAL FIELDS AND "EXPONENTIATION". Czyż, W.; Kabir, P.K. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794 and Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. D 11: No. 8, 2219-2222 (15 Apr 1975).

A semiclassical description allows a simple geometrical interpretation of the condition ($g = 2$) found by Weinberg, generalizing earlier results of Cheng and Wu, and Meng, for "exponentiation" of the scattering amplitude for high-energy particles by external electromagnetic fields. The same argument shows that the presence of any nonzero electric dipole moment is inimical to exponentiation. Similar discussion of scattering of isospin-bearing particles by a given Yang-Mills field leads to the conclusion that exponentiation cannot be expected to occur for that case. (auth)

16138 NON-ABELIAN GAUGE THEORIES OF STRONG INTERACTIONS AND SPECTRAL-FUNCTION SUM RULES. Hagiwara, T.; Mohapatra, R.N. (Department of Physics, The City College of The City University of New York, New York, New York 10031). Phys. Rev. D 11: No. 8, 2223-2226 (15 Apr 1975).

We present a diagram technique to isolate the leading singularities in the vacuum expectation values of current products, thereby making it possible to study the question of convergence of spectral-function sum rules associated with the currents. Working within asymptotically free theories, we derive certain sum rules, notable among them being Weinberg's first and second sum rules, which are shown to be valid if the strong interaction is globally SU(2) $\times$ SU(2) invariant. (auth)

16139 POLES WITH BOTH MAGNETIC AND ELECTRIC CHARGES IN non-Abelian GAUGE THEORY. Julia, B.; Zee, A. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 8, 2227-2232 (15 Apr 1975).

We show that a non-Abelian gauge theory with Higgs fields exhibits classical solutions which are both electrically and magnetically charged. This represents a specific realization of the dyons discussed some years ago by Schwinger. At the classical level the electric charge of the dyon does not appear to be quantized. We present some remarks in this connection. (auth)

16140 RENORMALIZATION-GROUP EQUATION FOR HIGH-ENERGY WIDE-ANGLE SCATTERING IN ϕ^4 THEORY. Tiktopoulos, G. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 11: No. 8, 2252-2259 (15 Apr 1975).

It is shown that the scattering amplitude in ϕ^4 theory obeys the renormalization-group equation in the limit of high energy for fixed wide scattering angle. It is conjectured that this feature is common to all renormalizable field theories involving spinor and/or scalar fundamental fields but no vector fields. (auth)

16141 MONOPOLE THEORIES WITH MASSLESS AND MASSIVE GAUGE FIELDS. Balachandran, A. P.; Rupertsberger, H.; Schechter, J. (Department of Physics, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 11: No. 8, 2260-2271 fields but no vector fields. (15 Apr 1975).

We investigate magnetic-monopole-type theories, including those where the gauge field acquires a mass. The study is based on a modification of Zwanziger's local Lagrangian formulation of the usual (zero-mass) theory. The quantization is carried out by using Dirac's general method. For the mass-zero case the known results are recovered including the charge-quantization condition. The Hamiltonian and angular momentum for the massive case are derived and discussed. Further, it is shown how Nambu's static phenomenological Hamiltonian can be derived as a special case of the massive theory. Certain difficulties associated with the rotational invariance of such theories are pointed out. (auth)

16142 CALCULATION OF ASYMPTOTIC BEHAVIOR OF FORM FACTORS IN non-Abelian GAUGE THEORIES. Carazzone, J.J.; Poggio, E.C.; Quinn, H.R. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 8, 2286-2299 (15 Apr 1975).

We calculate the leading contributions to the fermion–fermion–vector-meson form factor with non-Abelian gluons exchanged between the fermions in the region $-q^2 \gg p^2$, $p^2 > m^2$, q^2 spacelike, to sixth order in perturbation theory. For either incoming photon or gluon we obtain a result which shows that these contributions do not add to give a simple form. This paper presents the calculation in detail. (auth)

16143 FERMION-POMERON INTERACTIONS IN A REGGEON FIELD THEORY. Savit, R.; Bartels, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 11: No. 8, 2300-2315 (15 Apr 1975).

A Reggeon field theory which describes the interaction of a Pomeron with a pair of fermions of opposite parity is studied using the renormalization group and the ϵ expansion. In the infrared limit a

solution is found with a number of physically attractive features. The renormalized fermion trajectories are nearly proportional to u for small u even though the bare trajectories were proportional (for small u) to $\sqrt{u}$. Furthermore, both renormalized parity poles are on the physical j-plane sheet for $u < 0$, but one of them moves under a cut for $u > 0$ and does not appear as a physical particle—all this despite the fact that the bare theory has physical fermions of both parities. Phenomenological implications for backward π-N scattering, and implications for the general structure of Reggeon field theories are also discussed. (auth)

16144 MODIFIED FIELD THEORY FOR QUARK BINDING. Kiskis, J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 8, 2178-2202 (15 Apr 1975).

We have investigated the structure of modified field theories. Higher derivatives are introduced into the Lagrangian in such a way that the bare propagator becomes q^{-4} rather than q^{-2}. A modification of this type to the gluon propagator in a quark-gluon model gives the possibility of permanent quark binding. We find that such a model has difficulties with unitarity and with infrared divergences when treated in naive perturbation theory. If the problems associated with going beyond perturbation theory can be overcome, these difficulties may be eliminated. (auth)

16145 GAUGE FIELDS ON A LATTICE. III. STRONG-COUPLING EXPANSIONS AND TRANSITION POINTS. Balian, R.; Drouffe, J.M.; Itzykson, C. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP No. 2-91190 Gif-sur-Yvette, France). Phys. Rev. D 11: No. 8, 2104-2119 (15 Apr 1975).

We discuss the principles of the high-temperature expansion leading to a variation-perturbation method. For pure gauge fields, diagrams are two-dimensional manifolds. As an application, we compute the critical coupling constants for discrete, Abelian, and SU(2) gauge groups and compare them with some earlier results. (auth)

16146 QUANTUM SINE-GORDON EQUATION AS THE MASSIVE THIRRING MODEL. Coleman, S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 8, 2088-2097 (15 Apr 1975).

The sine-Gordon equation is the theory of a massless scalar field in one space and one time dimension with interaction density proportional to $\cos\beta\varphi$, where β is a real parameter. I show that if β^2 exceeds 8π, the energy density of the theory is unbounded below; if β^2 equals 4π, the theory is equivalent to the zero-charge sector of the theory of a free massive Fermi field; for other values of β, the theory is equivalent to the zero-charge sector of the massive Thirring model. The sine-Gordon soliton is identified with the fundamental fermion of the Thirring model. (auth)

16147 PHOTON DISPERSION IN A STRONG MAGNETIC FIELD. Shabad, A.E. (P. N. Lebedev Physical Institute, USSR, Moscow). Ann. Phys. (N.Y.) 90: No. 1, 166-195 (Mar 1975).

In an external magnetic field analytical properties are studied of the photon polarization tensor calculated as the electron-positron loop in the Furry picture. The polarization tensor is reexpressed as a sum over singular contributions coming from e^+e^--pair photocreation in semidiscrete Landau states. The solutions of the photon dispersion equation (i.e., the one for the poles of the photon propagator) are described. The shape of the photon dispersion curve obtained is responsible for the effect of photon deflection by a strong magnetic field. No physically reliable solutions, apart from spurions, are found for the longitudinal photon mode. An infinite number of solutions with complex space-momentum are found, with no apparent ghosts among them. An attempt is made to interpret the former in terms of possible bound and quasibound states of electron and positron pairs. (auth)

16148 SUPERGAUGE RENORMALIZABLE THEORY OF MASSIVE VECTOR FIELD. Likhtman, E.P. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 21: No. 4, 109-110 (20 Feb 1975).

We consider a supergauge theory, in which an Abelian massive vector field interacts with a nonconserved current. The renormalizability of the unity S matrix on the mass shell is proved by a transition to a nonunitary representation of the algebra of supergauge transformations. (auth)

16149 ON A CLASS OF SUPERGAUGE LAGRANGIANS. West, P. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Nucl. Phys., B; 91: No. 2, 289-300 (2 Jun 1975).

It is shown that the Wess-Zumino Lagrangian is the only viable supergauge Lagrangian which can be constructed from scalar superfields (and the covariant derivative) that has an interaction cubic in the scalar superfield. (auth)

Gravitation and General Relativity

Refer also to abstracts 15233, 15524, and 16094.

16150 SINGULARITY-FREE SOLUTION FOR A CHARGED FLUID SPHERE IN GENERAL RELATIVITY. Krori, K. D.; Barua, J. (Cotton Coll., Gauhati, India). J. Phys., A (London); 8: No. 4, 508-551(Apr 1975).

A singularity-free solution for a static charged fluid sphere in general relativity is obtained. The solution satisfies physical conditions inside the sphere. (auth)

16151 PHYSICAL INTERPRETATION OF PARAMETERS IN A GENERALIZED SOLUTION OF KERR-NUT (NEWMEN-UNTI-TAMBURINO). Semenov, V. P. (All Union-Scientific-Research Inst. of Optical-Physical Measurements, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 11-17(1975). (In Russian).

A physical interpretation of the above parameters is given. With this purpose in mind, use is made of the theory of the multipole structure of gravitational sources which is developed within the framework of the formalism of Newmen-Penrose. The results introduce a number of new momenta into the treatment of the solution. (SJR)

16152 GRAVO-INERTIAL SYSTEMS OF REFERENCE IN KERR AND SCHWARTZSCHILD SPACES. Dozmorov, I. M. (All Union-Scientific Research Inst. of Optical-Physical Measurements, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 95-104(1975). (In Russian).

Gravo-inertial reference systems, which are an analog of inertial systems in plane space, are constructed in Kerr and Schwartzschild spaces. With their aid a determination is made of the energy, momentum, and angular moment of these systems. A form is found for writing the Kerr solution in coordinates of Bondy-Sax at an approximation of slow rotation. With this same approximation a new solution is found for the Einsteinian equations that describe the gravitational field of a rotating and radiating source. (SJR)

16153 INHOMOGENEOUS THICK PLATE IN GENERAL RELATIVITY. Horsky, J. (Dept. of Theoretical Physics and Astrophysics, Brno); Horska, M. Acta Phys. Pol., Ser.; B6: No. 2, 171-172(1975).

The explicit form of the interior and exterior metric is found for a special but reasonable case of an inhomogeneous mass distribution in a thick plane plate. (auth)

16154 METHODS OF DERIVING EXACT SOLUTIONS OF SPHERICAL SYMMETRY IN THE EINSTEIN-CARTAN THEORY FOR A PERFECT FLUID WITH A "CLASSICAL DESCRIPTION" OF SPIN. Kuchowicz, B. (Univ., Warsaw). Acta Phys. Pol., Ser.; B6: No. 2, 173-196(1975).

The Einstein-Cartan theory of gravitation allows for avoiding singularities. This idea is supported by giving exact solutions of cosmological equations which are extensions of the Friedmannian cosmology. Various singularity-free models of dust and radiative universes are constructed. Two general relations are given which allow for a transition from dust-filled to radiation-filled universes with the same value of the scale factor. These relations are characteristic of the Einstein-Cartan theory, and cannot be brought over into general relativity. It is shown how exact solutions of the Einstein-Cartan theory can be derived from known solutions of general relativity. This procedure, which may be applied to material spheres, is simple enough to generate a large set of useful solutions. Two examples are given. (auth)

16155 ELECTROMAGNETIC FIELD OF AN OSCILLATING DIPOLE IN SCHWARZSCHILD SPACE-TIME IN LINEAR APPROXIMATION. Herlt, E.; Stephani, H. (Univ., Jena, Ger.). Acta Phys. Pol., Ser.; B6: No. 2, 197-202(1975).

The electromagnetic field of an arbitrary source distribution in Schwarzschild space time is given in linear approximation, using the technique of Green's functions. For an oscillating dipole at infinity, the result is the generalized plane wave. This wave gives the usual deflection of light, and is the starting point for the exact solution of the problem of the diffraction of a plane wave at a Schwarzschild black hole. (auth)

16156 PROPAGATION OF ELECTROMAGNETIC PLASMA OSCILLATIONS IN THE GRAVITATIONAL FIELD. Ignat'ev, Yu. G. (Kazan State Univ.). Acta Phys. Pol., Ser.; B6: No. 2, 203-221(1975). (In Russian).

The theory of electromagnetic plasma oscillations in the strong gravitational field is constructed by using relativistic kinetic Boltzman equations. In the atmosphere plasma of neutron stars damping decrement of transverse electromagnetic oscillations

may be positive; in this case the electromagnetic oscillations increase, and plasma becomes unstable. This effect is discussed in its application to the pulsars model. (auth)

16157 SOLUTIONS OF THE EINSTEIN FIELD EQUATIONS FOR A ROTATING PERFECT FLUID. Part 2. Properties of the Flow-Stationary and Vortex-Homogeneous Solutions. Krasinski, A. (Inst. of Astronomy, Warsaw). Acta Phys. Pol., Ser.; B6: No. 2, 223-238(1975).

The first family of the flow-stationary and vortex-homogeneous solutions presented previously is investigated. Their symmetry group is shown to be 3-parametric, abelian and acting transitively on timelike hypersurfaces. Exterior solutions of the same symmetry are found and matched to the interior ones. The conformal curvature tensors are of Petrov Type I, with one exception which is of Petrov Type II. Matter filling the space-time is shown to consist of co-axial cylinders rotating with different angular velocities. The redshift is found to be strongly anisotropic. The equation of state appears to result from the field equations. (auth)

16158 SOLUTIONS OF THE EINSTEIN FIELD EQUATIONS FOR A ROTATING PERFECT FLUID. Part 3. A Survey of Models of Rotating Perfect Fluid or Dust. Krasinski, A. (Inst. of Astronomy, Warsaw). Acta Phys. Pol., Ser.; B6: No. 2, 239-240(1975).

A short survey of solutions of the Einstein field equations with rotating perfect fluid or dust as a source is given. It has the form of a table exhibiting all the coincidences between solutions found previously. (auth)

16159 COMPOSITE FIELD EXHIBITING PLANE SYMMETRY IN EINSTEIN'S UNIFIED FIELD THEORY. Tiwari, R.; Kashyap, J. N. S. (Banaras Hindu Univ., India). Indian J. Pure Appl. Math.; 3: No. 6, 1250-1255(Nov 1972).

A static plane symmetric field is considered and the exact solution of its field equations in Einstein's unified field theory is obtained. (auth)

16160 EQUATIONS OF HYDRODYNAMICS IN GENERAL RELATIVITY VIA A SLOW-MOTION EXPANSION OF AN INTEGRAL SOLUTION. DeCanio, T. C. New York; New York Univ. (1974). 81p. University Microfilms Order No. 74-29,969.

Thesis (Ph. D.).

By means of a formal solution to the Einstein gravitational field equations a slow-motion expansion in inverse powers of the speed of light is developed for the metric tensor. The formal solution, which satisfies the deDonder coordinate conditions and the Trautman outgoing-radiation condition, is in the form of an integral equation which is solved iteratively. A stress-energy tensor appropriate to a perfect fluid is assumed and all orders of the metric needed to obtain the equations of motion and conserved quantities to the $2^1/_2$ post-Newtonian approximation are found. (This is the approximation in which gravitational radiation reaction terms first appear.) The results of this method are compared to those previously obtained in another gauge by S. Chandrasekhar. They are shown to be equivalent to his, but require considerably less labor in their determination. In addition, the relation of the fast-motion approximation to the slow-motion approximation is examined. (Diss. Abstr. Int., B)

16161 INTRODUCTION TO GENERAL RELATIVITY. Atwater, H. A. International Series of Monographs in Natural Philosophy. Vol. 63. New York; Pergamon Press (1974). 230p. $11.00.

Material presented includes Newton's laws and the Galilean transformation, the Lorentz transformation, the world-line element, and the metric tensor and physical law. Tensor analysis is considered along with the equations of motion of free particles, solutions of the field equations, electromagnetism in general relativity, gravitational fields and waves, relativity in cosmology, unified theories and quantized theories of general relativity, and Minkowski's coordinates and orthogonal transformations. (Int. Aerosp. Abstr.)

16162 GHOST-FREE FORMULATION OF QUANTUM GRAVITY IN THE LIGHT-CONE GAUGE. Kaku, M. (City Coll., New York (USA). Dept. of Physics). Nucl. Phys., B; 91: No. 1, 99-108(26 May 1975).

By choosing the light-cone gauge, all redundant components of the metric tensor as well as all Faddeev-Popov ghosts are removed from the Einstein Lagrangian, from which Feynman rules for two independent transverse components can be immediately formulated. The 2 + 2 decomposition of the metric tensor proves to be simpler than the usual canonical 1 + 3 decomposition, so that all spurious components can be explicitly eliminated from the spectrum. Because the Lagrangian is now only a function of independent components, it is possible to study the unresolved problem of the functional measure for quantum gravity. The measure problem is being studied at present. (auth)

16163 A GENERALIZED LOVELOCK THEOREM FOR THE GRAVITATIONAL FIELD WITH TORSION. von der Heyde, P. (Technische Univ. Clausthal, Clausthal-Zellerfeld (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., A; 51: No. 7, 381-382(21 Apr 1975).

The U_4 field equations are uniquely determined up to three parameters if they are assumed to be polynomial in metric, torsion and their derivatives, respectively, and free of new fundamental constants. The parameters can be fixed by means of the equivalence principle. (auth)

16164 GRAVITATIONAL WAVE TAILS. Bonnor, W. B. pp 73-81 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

A review is given of previous work on tails emitted by an isolated, vibrating source. It appears that they are a real phenomenon, and cannot be transformed away. The tails arise in the scattering of multipole waves by the monopole field of the source, but not in multipole–multipole interactions. The r^{-1} expansion method is not suitable for dealing with tails. (auth)

16165 HOW TO TEST GRAVITATION THEORIES BY MEANS OF GRAVITATIONAL-WAVE MEASUREMENTS. Thorne, K. S. (California Inst. of Tech., Pasadena (USA)). pp 213-223 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

Gravitational-wave experiments are a potentially powerful tool for testing gravitation theories. Most theories in the literature predict rather different polarization properties for gravitational waves than are predicted by general relativity; and many theories predict anomalies in the propagation speeds of gravitational waves. (FR)

16166 GRAVITATIONAL WAVES AND MACH'S PRINCIPLE. Sciama, D. W. (International Centre for Theoretical Physics, Trieste (Italy)). pp 267-282 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

In formulating Mach's principle in general relativity it is essential to distinguish between wave and static contributions of $T^{\mu\nu}$ to $g^{\mu\nu}$. The former propagate on or inside the light cone, while the latter are instantaneous. Thus it is not correct in general to state Mach's principle in terms of the vanishing of a surface integral at infinity in the Green's function representation of general relativity. A brief description is given of Raine's solution of this problem and its consequences are compared with recent observations of the angular distribution of the microwave background. (auth)

16167 A NEW COVARIANT THEORY OF GRAVITATION. Rosen, N. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). pp 285-299 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

A bi-metric theory of gravitation is proposed, satisfying the covariance and equivalence principles and based on a simple form of Lagrangian. The field equations have a simpler structure than those of the general relativity theory. The predictions of this theory agree with those of general relativity to the accuracy required by present-day observations. However, the proposed theory does not involve any black hole in the static spherically symmetric case. (auth)

16168 EQUATIONS OF MOTION RADIATION REACTION, AND GRAVITATIONAL RADIATION. Havas, P. (Goettingen Univ. (F. R. Germany). pp 383-392 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The various "slow" and "fast" approximation methods developed for the problem of the rate of emission of radiation from a system of particles moving under the influence of their gravitational interactions are reviewed briefly, stressing the differences between this and the corresponding electrodynamic problem. A

new "fast" approximation method is outlined, which yields equations of motion which are covariant to the order considered. The rate of emission of gravitational radiation by a two-particle system obtained by this method is discussed, and arguments are given why neither these nor earlier calculations can be considered to yield a conclusive answer to this problem. (auth)

16169 THE PRINCIPLE OF MATERIAL FRAME INDIFFERENCE IN GENERAL RELATIVITY AND THE FORMULATION OF CONSTITUTIVE EQUATIONS FOR RELATIVISTIC CONTINUOUS MATTER. Maugin, G. A. (Paris-6 Univ., 75 (France)). pp 331-338 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

A statement of the principle of material frame indifference (objectivity) is given in general relativity which is closely related to that of classical mechanics and allows one to find necessary and sufficient conditions to construct reduced "good" constitutive equations. A number of applications to different classes of materials (general, solids, fluids) is given without proof. (auth)

16170 POST-NEWTONIAN GENERATION OF GRAVITATIONAL WAVES. Epstein, R.; Wagoner, R.V. (Institute of Theoretical Physics, Department of Physics, Stanford University). Astrophys. J. 197: No. 3, 717-723 (1 May 1975).

An analysis is presented of gravitational radiation from astrophysical bodies, in terms of an expansion in powers of (velocity) $\sim$ (Newtonian potential)$^{1/2}$ within general relativity. Explicity expressions are obtained for the distant radiation field and energy flux from perfect-fluid sources, valid through 3/2 post-Newtonian order (beyond the usual formulae). (auth)

16171 THE *N*-BODY PROBLEM IN GENERAL RELATIVITY. Spyrou, N. (University of Thessaloniki, Greece). Astrophys. J. 197: No. 3, 725-743 (1 May 1975).

The form of the metric tensor in the first and 2 1/2 post-Newtonian (PNA) is derived, and the method for its evaluation in the second PNA is presented for a system of N bodies, which are spherical, homogeneous, and rotate uniformly around axes through their centers. The energy, linear-momentum, and angular-momentum integrals up to the first PNA are also derived for the above system. The expressions found consist of "point-like," "structure," and "rotation" terms. The "pointlike" terms coincide with those given by previous authors. The "structure" and "rotation" terms depend on the radius, internal energy, angular velocity of the spheres. In a particular numerical application we give the first PNA correction in the energy integral. This increases with increasing mass, decreasing radius, and decreasing distance of the bodies, and becomes comparable to the Newtonian value of the energy for small distances and for radii approaching Schwarzschild radius. (auth)

16172 CYLINDRICALLY SYMMETRIC BRANS–DICKE FIELDS. III. Rao, J.R.; Tiwari, R.N.; Bhamra, K.S. (Department of Mathematics, Indian Institute of Technology, Kharagpur, 721302 (S. E. Rly), West Bengal, India). Ann. Phys. (N.Y.) 90: No. 2, 573-579 (Apr 1975).

In the previous work I and II, we have obtained a class of exact solutions for the Brans-Dicke scalar-tensor theory for Einstein-Rosen nonstatic cylindrically symmetric metric when only scalar field is present and then in presence of source-free electromagnetic field. In the present work we have developed a more general set of solutions from those given in I and II under the unit transformation by Morganstern [Phys. Rev. D 3 (1971), 2946]. These have been found to be the solutions of the Brans-Dicke scalar-tensor theory for the most general cylindrically symmetric metric of Marder. (auth)

16173 MANY-TIME HAMILTONIAN GRAVITATION THEORY. Teitelboim, C. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Phys. Lett., B; 56: No. 4, 376-378(12 May 1975).

It is shown that given any "good" coordinate condition in Hamiltonian general relativity one can construct an associated many-time formulation in which the constraints can be solved for some of the momenta as functionals of the remaining canonical variables. Since good coordinate conditions appear to be available for both open and closed spaces it follows that the functional wave equation for general relativity can be always put in a Tomonaga-Schwinger form. The implications of this result and some open problems are briefly discussed. (auth)

16174 METRIC OF A RADIATING ROTATING SPHERE. Carmeli, M.; Kaye, M. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Phys. Lett., A; 53: No. 1, 14-16(19 May 1975).

A nonstationary solution of the Einstein field equations, corresponding to the field of a radiating rotating sphere is presented. The new metric bears the same relation to the Kerr metric as does Vaidya's metric to the Schwarzschild metric. (auth)

16175 GRAVITATION AND SOURCE THEORY. Yilmaz, H. (Perception Technology Corporation, 95 Cross Street, Winchester, Massachusetts 01890). Ann. Phys. (N.Y.) 90: No. 1, 256-265 (Mar 1975).

Schwinger's source theory is applied to the problem of gravitation and its quantization. It is shown that within the framework of a flat-space the source theory implementation leads to a violation of probability. To avoid the difficulty one must introduce a curved space-time hence the source concept may be said to necessitate the transition to a curved-space theory of gravitation. It is further shown that the curved-space theory of gravitation implied by the source theory is not equivalent to the conventional Einstein theory. The source concept leads to a different theory where the gravitational field has a stress-energy tensor t_{μ}^{ν} which contributes to geometric curvatures. (auth)

16176 SPHERICAL MASS IMMERSED IN A COSMOLOGICAL UNIVERSE: A CLASS OF SOLUTIONS. Eisenstaedt, J. (Laboratoire de Physique Théorique, Institut Henri Poincaré, 11, rue Pierre et Marie Curie, 75231 Paris Cedex 05). Phys. Rev. D 11: No. 8, 2021-2025 (15 Apr 1975).

A new exact solution of the Einstein field equations in the spherical case is developed and utilized for constructing a model representing a spherical mass immersed in a cosmological universe. (auth)

16177 PHYSICAL CONSEQUENCES OF A SOLUTION OF THE NONSYMMETRIC UNIFIED FIELD THEORY. Boal, D.H.; Moffat, J.W. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. D 11: No. 8, 2026-2030 (15 Apr 1975).

The physical consequences and possible tests of our solution of the nonsymmetric unified field theory of gravitation and electromagnetism are discussed. It is found in general that a universal constant k introduced in the unification of the theory shows itself as a fourth-order effect in the propagation of light near a charged body. Further, it is shown that magnetic monopoles are not an allowed solution of the theory. (auth)

16178 TWISTOR VARIABLES OF RELATIVISTIC MECHANICS. Perjés, Z. (Central Research Institute for Physics, Budapest 114, Hungary). Phys. Rev. D 11: No. 8, 2031-2041 (15 Apr 1975).

This paper is concerned with the description of noninteracting dynamical systems in Penrose's twistor theory. We begin with an introduction to the formal treatment of massive systems relying on the angular momentum twistor $A^{\alpha\beta}$. Expressions for dynamical data in terms of $A^{\alpha\beta}$ are given. The internal-symmetry transformations involved in the parametrization of $A^{\alpha\beta}$ by one-index twistors are shown to be of the canonical type. The case of two supporting twistors is discussed in detail. Relative to the frame of these twistors (a rest frame of the dynamical system) the classical spin has the remarkable structure $\vec{s} = \bar{\psi}\vec{\sigma}\psi$. When decomposing $A^{\alpha\beta}$ into three twistors, the minimal symmetry transformations define a 14-parameter group. We show that this group of symmetries is locally isomorphic to the inhomogeneous SU(3). (auth)

16179 NONRADIATIVE AND AXIALLY SYMMETRIC VACUUM FIELDS. Berezdivin, R.; Herrera, L. (Departamento de Física, Facultad de Ciencias, Universidad Central de Venezuela, Caracas, Venezuela). Phys. Rev. D 11: No. 8, 2063-2071 (15 Apr 1975).

Using the formalism of Bondi *et al.* we show that, in an axially symmetric asymptotically flat vacuum space-time, the existence of another isometry causes all possible solutions to be nonradiative. (auth)

16180 Type-*N* GRAVITATIONAL FIELD WITH TWIST-ANALYTICAL ADDENDUM TO HAUSER'S SOLUTION. Novoseller, D. (California Institute of Technology, Pasadena, California 91125). Phys. Rev. D 11: No. 8, 2330-2331 (15 Apr 1975).

Hauser has presented a type-N gravitational field with twist in terms of a function $f(y)$, which he expressed as the solution of a differential equation. The exact solutions of this equation are presented here as Gauss hypergeometric functions. (auth)

16181 ON THE RELATIVISTIC THEORY OF ELECTROMAGNETIC DISPERSION RELATIONS AND POYNTING'S THEOREM. Lerche, I. (Enrico Fermi Institute and Department of Physics, University of Chicago). Astrophys. J. Suppl. Ser. 29: No. 279, 113-122 (Apr 1975).

Constitutive relations, and general dispersion relations, are derived for an arbitrary, anisotropic, dispersive and dissipative medium which is moving relative to an inertial observer. The constitutive relations are expressed in terms of the "local" dielectric tensor, magnetic permeability, etc., where "local" refers to the instantaneous rest frame of the medium. We also give the generalization of Poynting's theorem for power flow including the expression for the rate at which the moving medium does work on the radiation. In view of the current interest in radiation generated in, and passing through, pulsar magnetospheres, we believe that the general results presented here are, perhaps, not without some astrophysical import. (auth)

16182 INFLUENCE OF GRAVITATION ON THE PROPAGATION OF ELECTROMAGNETIC RADIATION.

Mashhoon, B. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 11: No. 10, 2679-2684 (15 May 1975).

The existence of a general helicity-rotation coupling is demonstrated for electromagnetic waves propagating in the field of a slowly rotating body and in the Gödel universe. This coupling leads to differential focusing of circularly polarized radiation by a gravitational field which is detectable for a rapidly rotating collapsed body. The electromagnetic perturbations and their frequency spectrum are given for the Gödel universe. The spectrum of frequencies is bounded from below by the characteristic rotation frequency of the Gödel universe. If the universe were rotating, the differential focusing effect would be extremely small due to the present upper limit on the anisotropy of the microwave background radiation. (auth)

16183 GRAVITATIONAL RADIATION FROM LASER PULSES. Adler, R.J. (Institute for Advanced Study, Princeton, New Jersey 08540 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 10, 2685-2688 (15 May 1975).

We study the gravitational radiation emitted by a laser pulse or other pulse of light reflected from a mirror. The angular distribution and magnitude of radiated gravitational energy are obtained in a simple manner. Convenient order-of-magnitude relations for the power output of such high-velocity sources are obtained, and the feasibility of detecting laboratory-generated gravitational radiation is discussed. (auth)

16184 INTERIOR SOLUTIONS TO PLANE-SYMMETRIC EINSTEIN-MAXWELL EQUATIONS. Humi, M.; LeBritton, J.A. (Worcester Polytechnic Institute, Worcester, Massachusetts 01609). Phys. Rev. D 11: No. 10, 2689-2691 (15 May 1975).

For zero pressure we obtain an interior solution to plane-symmetric Einstein-Maxwell equations. For the general case we assume a functional relationship between the coefficients of the metric and show that the solution can be written in an integral form. (auth)

16185 MAGNETIC-MONOPOLE SOLUTION OF NON-ABELIAN GAUGE THEORY IN CURVED SPACETIME. Bais, F.A.; Russell, R.J. (Physics Department, University of California, Santa Cruz, Santa Cruz, California 95064). Phys. Rev. D 11: No. 10, 2692-2695 (15 May 1975).

A magnetic-monopole solution of a non-Abelian gauge theory as proposed by t'Hooft is studied in curved spacetime. Einstein's equations are solved for the case of a magnetic point charge yielding a metric identical to the Reissner-Nordström metric, except that a nonvanishing cosmological constant is invoked. (auth)

16186 FURTHER REMARKS ON THE LOCAL-SCALE-INVARIANT THEORY OF GRAVITATION. Omote, M. (Department of Physics, The University of Tsukuba, Tsukuba, 300-31, Japan). Phys. Rev. D 11: No. 10, 2746-2751 (15 May 1975).

The local-scale-invariant theory of gravitation in terms of Weyl's geometry, which was proposed in our previous paper, is reexamined, and the conservative laws for the current and for the total energy-momentum pseudotensor are obtained. The problem of the physical identity of the gauge field is discussed, with the conclusion that the gauge field can in fact be identified with the electromagnetic field. (auth)

16187 AFFINE-PROJECTIVE FIELD LAWS. Murphy, G.L. (Department of Physics, Westminster College, New Wilmington, Pennsylvania 16142). Phys. Rev. D 11: No. 10, 2752-2761 (15 May 1975).

The general topic of geometric unified field theories is discussed in the first section. Some reasons are given for pursuing such theories, and some criticisms are considered. The second section develops the fundamental equations of a purely affine theory which is invariant under projective transformations of the affine connection. This theory is a generalization of that of Schrödinger. Possible identifications for the space-time metric are considered in Sec. III. Sections IV and V deal with the limits of pure gravitation and electrodynamics. In the symmetric limit, Einstein's vacuum equations with cosmological term are recovered. The theory also contains a generalized electrodynamic set of equations which is very similar to the Born-Infeld set. In the weak-field approximation, a finite mass must be attributed to the photon. The problem of motion for charges is discussed here, and it is argued that criticisms of unified field theories because of a supposed inability to produce the Lorentz force law are probably not justified. Three more speculative sections deal with possible explanations of nuclear forces, the spin-torsion relation, and particle structure. (auth)

16188 GYROMAGNETIC RATIO OF EINSTEIN-MAXWELL FIELDS. Reina, C.; Treves, A. (Istituto di Fisica dell' Università and Laboratorio di Fisica Cosmica e Tecnologie Relative, Milano, Italy). Phys. Rev. D 11: No. 10, 3031-3032 (15 May 1975).

It is shown that the gyromagnetic factor is $g = 2$ for electrovac solutions of Einstein's equations obtained by the prescription introduced by Ernst. This generalizes Carter's result for the Kerr-Newman metric. (auth)

REACTOR TECHNOLOGY AND REGULATION

16189 (ERDA-14) PROCEEDINGS OF THE AEC/ANS NUCLEAR ENGINEERING DEPARTMENT HEADS WORKSHOP ON RESEARCH IN NUCLEAR POWER SYSTEMS, GERMANTOWN, MARYLAND, OCTOBER 24–25, 1974. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). 1974. 211p. (CONF-7410122-). Dep. NTIS $13.75.

Topics covered in the workshop discussions and position papers include the following: LWR safety, LMFBR technology and safety, CTR technology, waste management, and university involvement in nuclear engineering. (JWR)

16190 (NP-20428) GYLLING NAES NUCLEAR POWER STATION. (Jysk-Fynske Elsamarbejde (ELSAM), Fredericia (Denmark)). Jun 1974. 14p. (In Danish). Dep. NTIS (US Sales Only) $4.00.

Brochure briefly listing authorities involved in and methods used for selection of location—Gylling Naes—Denmark's first planned nuclear power station. Reasons for choice of site, consequences for local population, evacuation plans, etc., are described. Maps of the site are given. (DE)

16191 DEVELOPMENT OF NUCLEAR POWER IN CZECHOSLOVAKIA. Neumann, J. (Atomic Energy Commission, Prague). Kernenergie; 18: No. 4, 93-99(Apr 1975). (In German).

The main stages of Czechoslovak nuclear power evolution are outlined, starting from foundation of the Nuclear Research Institute at Řež near Prague to erection of the first Czechoslovak nuclear power station A-1 at Jaslovské Bohunice and beginning of constructional works on the two nuclear power stations at Jaslovské Bohunice and Dukovany provided with 440-MW light-water reactors. This development has been made possible as a result of the broad assistance given by the USSR. Agreements have also been come to with the USSR providing for total nuclear power of 5000 MW(e) in Czechoslovakia in 1985. In this connection, the role of Czechoslovak metallurgical and mechanical engineering in designing and constructing components for Czechoslovak nuclear power plants and, moreover, within the scope of an integrated nuclear power industry of the CMEA member states is pointed out. (auth)

16192 SUMMARY OF OPERATING US POWER REACTORS AS OF MAY 1, 1975. Nucl. Saf.; 16: No. 4, 512-514(1975).

Tabulated data on operating U. S. power reactors are presented. (JWR)

16193 NUCLEAR POWER-PLANT OPERATING EXPERIENCE DURING 1973. Nucl. Saf.; 16: No. 4, 488-496(1975).

Results of a review of the operating experience of 30 U. S. nuclear power plants in commercial operation in 1973 are presented. The review, performed by the AEC Office of Operations Evaluation, included power-generation statistics, plant outages, fuel-element performance, surveillance test results, radiation exposures, radioactive effluent releases, and abnormal occurrences. These power plants contributed about 4 percent of the total electrical energy generated in the United States during 1973. The average power-plant availability factor was 71 percent, and the average plant capacity factor was 56 percent. No adverse effect on the public health and safety resulted from operation of the plants. (auth)

16194 NUCLEAR POWER PLANTS: WHAT IT TAKES TO GET THEM BUILT. Budwani, R. N. Power Eng.; 79: No. 6, 38-45(Jun 1975).

Many measures are possible which can cut dramatically the man-power, material, and capital required to build power plants, as presently projected. Project times may be slashed as well. A vital first step in support of corrective action has been taken, as detailed here—that of breaking down the material, manpower, cost, and schedule performance of nuclear plants, both built and planned, from the late-1960s to the mid-1980s. The ranges of values found in the breakdowns raise interesting questions and provide guides for future action. (auth)

16195 FLOATING NUCLEAR POWER PLANTS. Fernandez, N. M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 19: No. 94, 81-90(1975). (In Spanish).

A type of nuclear power plant that minimizes siting requirements is discussed. After a brief review of studies made on floating nuclear power plants, the two most concrete proposals are examined. The possible differences between existing nuclear power plants and the proposed floating plants are indicated with reference to siting requirements and environmental aspects. The special requirements for obtaining installation licences for this type power plant are also examined. (tr-auth)

16196 CONVERTER REACTOR ALTERNATIVES. Davis, W. K. Combustion,; 46: No. 12, 25-31(Jun 1975).

From Atomic Industrial Forum conference on energy alternatives–technologies, economics, and priorities; Washington, DC (19 Feb 1975).

The role of converter reactors, including PWR's, BWR's, HTGR's, and PHWR's (CANDU), in meeting energy needs is examined. Topics discussed include growth in power demands, economics, capital requirements, scheduling, and uranium supply and enrichment. (JWR)

16197 TURNING THE FIRST SOD FOR THE NUCLEAR POWER PLANT SIMULATION CENTRE. VGB Kraftwerkstech.; 55: No. 1, 1-4(Jan 1975). (In German).

Groundbreaking for the nuclear power plant simulator centre (KSZ) of Kraftwerksschule e.V., Essen, could take place on 11th December 1974. Through the nuclear power plant simulator centre, the Kraftwerksschule (power plant school) will be extended by a modern installation which is to accommodate the simulator training of operating personnel for nuclear power plants in the year 1976. It will thus make an important contribution to the operation with optimum availability of some 40 nuclear power plants which are expected to be in operation by 1985 in the Federal Republic of Germany and simultaneously to securing the energy supply. (auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 15029, 16525–16527, 16531, 16539, 16545, 16550, 16551, 16560–16562, 16564, 16566, 16568, 16572, 16593, 16603, 16628, 16664, 16665, 16668, 16670, and 16671.

16198 SOME EXPERIENCES FROM MONITORING OF WORKING ENVIRONMENT DURING PERIODICAL EXAMINATION OF NUCLEAR REACTOR OF THE FUKUSHIMA I NUCLEAR POWER PLANT. Fojtik, M. (Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 67-71 of Proceedings of the 6th Conference on Radiation Hygiene. I. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P1.

Obtained results show that airborne contamination depends on the working conditions at the actual place. After opening the reactor vessel head, mainly iodine radionuclides in air were detected. During preparatory works for dismounting the inner auxiliary equipments the increased concentration of corrosion products was observed. This type of airborne contamination was in direct relation to the number of engaged workers on the place. From the preliminary evaluation of results of determination of aerosol concentration in air follows that in both cases of reactor hall and dry well and turbine room were airborne concentrations below the maximum permissible level recommended by ICRP. (auth)

16199 PROCESS OF RADIOACTIVE WASTE GASES. Queiser, H.; Schwarz, H ; Schroter, H. J. (to Licentia-Patent-Verwaltungs-G.m.b.H. and Bergwerksverband GmbH). US Patent 3,871,841. 18 Mar 1975. Priority date 1 Apr 1972, F. R. Germany. 6p.

A method is described in which the radiation level of waste gases from nuclear power plants containing both activation and fission gases is controlled at or below limits permitted by applicable standards by passing such gases, prior to release to the atmosphere, through an adsorptive delay path including a body of activated carbon having the relation to the throughput and character of such gases. (Official Gazette)

16200 EXHAUST GAS CLEANING SYSTEM FOR HANDLING RADIOACTIVE FISSION AND ACTIVATION GASES. Queiser, H.; Schwarz, H. (to Licentia-Patent-Verwaltungs-G.m.b.H.). US Patent 3,871,842. 18 Mar 1975. Priority date 5 Jul 1971, F. R. Germany. 8p.

An exhaust gas cleaning system utilizing the principle of delaying radioactive gases to permit their radioactive decay to a level acceptable for release to the atmosphere, comprising an adsorbent for adsorbing radioactive gas and a container for containing the adsorbent and for constraining gas to flow through the adsorbent, the adsorbent and the container forming simultaneously an adsorptive delay section and a mechanical delay section, by means of a predetermined ratio of volume of voids in the adsorbent to total volume of the container containing the adsorbent, for delaying radioactive gas to permit its radioactive decay to a level acceptable

for release to the atmosphere is described. A method of using an adsorbent for cleaning a radioactive gas containing an isotope which is adsorbed by the adsorbent and containing an isotope whose adsorption by the adsorbent is low as compared to the isotope which is adsorbed and which is short-lived as compared to the isotope which is adsorbed, comprising constraining the gas to flow through the adsorbent with the retention time for the isotope which is adsorbed being at least the minimum for permitting radioactive decay to a level acceptable for release to the atmosphere and with the retention time for the isotope of relatively low adsorption and relatively short life being at least the minimum for permitting radioactive decay to a level acceptable for release to the atmosphere is also described. (Official Gazette)

16201 AN ANTI-SEISMIC SUPPORTING DEVICE FOR THE VESSEL OF A NUCLEAR REACTOR. Costes, D. (to CEA, 75 - Paris (France)). French Patent 2,214,158/A/. 11 Jan 1973. 6p. (In French).

The device is characterized in that the bearing surface of the supporting block is a concave surface of revolution about a vertical axis coinciding with that of the reactor vessel. The vessel lower bearing surface comprises a convex surface mating the concave surface and the two surfaces rest on each other through deformable shoes regularly distributed along at least one circle of the concave surface. The device can be applied to boiling water reactors. (FR)

16202 PROBLEMS CONNECTED WITH WATER CHEMISTRY IN THE PRIMARY CIRCUITS OF LIGHT-WATER REACTORS. Dolle, L.; Rozenberg, J.; Darras, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Recherche et Analyse). pp 80-81 of La maturite de l'energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The pressurized water type reactors have a completely closed primary circuit whereas the boiling water reactors are designed with a direct cycle and the condensate from the turbine is brought through heaters back into the core. The chemical reactivity control by a soluble poison in the PWR type reactors adds a further distinction. The water purification processes used in the two cases are therefore different. Some special aspects, which have appeared recently, are described: chemical purity of the water; transport of corrosion products in the circuits; filtration of corrosion products; decontamination in situ; radiolytic decomposition of water; chemical reactivity control and tritium formation. (FR)

16203 RELEASE OF RADIOACTIVITY IN EFFLUENTS AND SOLID WASTE FROM WATER COOLED NUCLEAR POWER PLANTS. Radioprotection; 9: No. 2, 141-149(1974). (In French).

The values of the activities released in liquid (including tritium) and gaseous effluents are presented for 1970-1972 as well as the volumes and activities of solid waste for 1972 from U. S. BWR and PWR and Chooz nuclear plant. The latter plant is among those with the larger liquid and tritium releases. PWR released more noble gases but less aerosols and volatile products. (FR)

16204 UO_2-ZIRCALOY FUEL ELEMENTS. Testing to Limits, Operation with Molten Oxide. Bazin, J.; Contenson, G. de; Vignesoult, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). pp 91-94 of La Maturite de l'energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

An irradiation program was undertaken, within the scope of light-water reactor studies, to determine under what conditions a specific power implying a limited molten zone is consistent with good in-pile behavior and correct length of life of the pins. Two types of pins were tested (PWR geometry; BWR geometry). The behavior of the pins and their component parts was studied together with the effects of the cooling method and the power variations on the type of structure observed at the end of life and the quantitative and qualitative knowledge of fission products in the fuel and at the oxide-cladding contact. (FR)

16205 IRRADIATION BEHAVIOR OF PLUTONIUM FUELS FOR LWR. Bairiot, H.; Gaube, M.; Van Outryve d'Ydewalle, B. (Societe Belge pour l'Industrie Nucleaire, Brussels). pp 98-100 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The behavior of mixed-oxide fuels with stainless steel or zircaloy cladding was studied. 900 rods were irradiated in various power reactors. The results presented indicate that in most cases, the performances of the mixed-oxide fuels have been very satisfactory. (FR)

16206 OXIDE-CLADDING REACTIONS AND THEIR EFFECT ON WATER REACTOR FUEL COLUMN BEHAVIOR. Bazin, J.; Jouan, J.; Vignesoult, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). pp 94-96 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The oxide-cladding reactions linked to the presence of fission products create local blockages of the fuel on the cladding. These blockages cause the UO_2 columns to fragment and shrink in length. A curve was plotted that shows the conditions under which the oxide-cladding reaction appears at burnup between 10,000 and 25,000 MWd/MTU. (FR)

16207 LIGHT-WATER FUEL IRRADIATION IN THE PAT, FROM 1969 TO 1974. Watteau, M.; Delafosse, J.; de Contenson, G.; Lestiboudois, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). pp 96-98 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

UO_2-Zircaloy rod assemblies were irradiated in the III core of the PAT (ground based prototype) unit at Cadarache and in the BR 3 reactor at Mol in Belgium. After irradiation, the assemblies were checked out. The examinations of the assemblies irradiated in BR 3 confirm the excellent behavior of the pins whose geometry and service conditions are very like those of the fuel elements in pressure water reactors. The examinations of the assemblies irradiated in the PAT enable to observe the consequences of lengthy time in operation in more stringent conditions than those imposed on electronuclear plant fuels. (FR)

16208 BWR PLANT STANDARDIZATION UTILIZING GESSAR AND STRIDE. Geurts, J. R. (General Electric Co., San Jose, CA); Patterson, D. R.; Schlinger, E. P. Proc. Am. Power Conf.; 36: 107-116(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the specifications for the reactor building, fuel building, auxiliary building, radwaste building, control building, diesel generator buildings, plant licensing procedures, and design criteria. (DCC)

16209 APPLICATION OF PLANT OUTAGE EXPERIENCE TO IMPROVE PLANT PERFORMANCE. Bridenbaugh, D. G.; Burdsall, G. D. (General Electric Co., San Jose, CA). Proc. Am. Power Conf.; 36: 143-150(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

A review of BWR performance and operating efficiency is presented. The optimizing of reactor refueling and maintenance outages is discussed. (DCC)

16210 POST-LOCA HYDROGEN RECOMBINER SYSTEM FOR LWR NUCLEAR PLANTS. Henrie, J. O. (Atomics International, Canoga Park, CA); Gregor, F. E.; Honkala, J. W. Proc. Am. Power Conf.; 36: 219-225(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

A comparison of flame recombiners, catalytic recombiners, and thermal recombiners is presented. The design characteristics of the thermal recombiners for the Enrico Fermi-2 Reactor are described. (DCC)

16211 ADVANCES IN THE APPLICATION OF PRECOAT FILTERS AND FILTER DEMINERALIZERS IN NUCLEAR POWER PLANTS. Becker, C. H.; Brown, J. S. (DeLaval Turbine, Inc., Florence, NY). Proc. Am. Power Conf.; 36: 736-744(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the use of powdered resin body feed for condenser leaks, the AEC regulation on reserve demineralization capacity, radwaste and operating costs of deep-bed versus filter/demineralizers, and the use of powdered resins for radwaste applications. (DCC)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 15029, 16202–16207, 16210, 16525, 16526, 16530–16532, 16538, 16545, 16548–16551, 16560–16562, 16564,

16566, 16567, 16572, 16628, 16661, 16664, 16665, 16668, 16670, 16671, and 16674.

16212 (BAW-10006A(Rev.3)) REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM. Snyder, G. J.; Carter, G. S. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1975. 35p. Babcock and Wilcox, Lynchburgh, VA.

B and W conducts surveillance programs for its 850-MW(e) class of reactors to determine the effects of neutron irradiation on the full Charpy V-notch curves of the reactor vessel materials. Charpy and tensile specimens, which are machined from as-fabricated metal, heat-affected-zone metal (HAZ), and weld metal, are placed in six surveillance capsules containing dosimeters and temperature monitors. The capsules are then placed in three holder tubes, which are positioned so that the capsules are near the peak axial neutron flux. (auth)

16213 (BAW-10080A(Rev. 1)) CADD: COMPUTER APPLICATION TO DIRECT DIGITAL SIMULATION OF TRANSIENTS IN WATER REACTORS. Stoudt, R. H.; Busby, S. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Dec 1974. 64p.

The CADD Fortran program solves the time-dependent neutron kinetics equations in conjunction with the thermal-hydraulic equations for an average fuel pin during a reactivity transient in a pressurized water reactor (PWR). The simulation includes the major feedback mechanisms as well as detailed single-phase, nucleate boiling, and film boiling core heat transfer models. CADD is also capable of simulating the entire reactor coolant loop, including the pressurizer. 10 references. (auth)

16214 (BAW-10084A) PROGRAM TO DETERMINE IN-REACTOR PERFORMANCE OF B AND W FUELS. Cladding Creep Collapse. Eckert, A. F. J.; Wilson, H. W.; Yoon, K. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1975. 63p.

An analytical procedure is described along with the experimental data developed by Babcock and Wilcox (B and W) to determine the minimum time to collapse for B and W fuel cladding under operating conditions. The resultant computer code is referred to as CROV. The analytical procedure was developed from the engineering principles of shell theory. The experimental data consisted of two types. One type of data was employed to develop empirical creep constants applicable to B and W fuel cladding. The other type of data provided an experimental comparison for the ovalities and collapse times predicted by CROV. 9 references. (auth)

16215 (BAW-10102(Rev.1)) ECCS EVALUATION OF B AND W's 205-FA NSS. Lowe, R. J.; Anderson, G. E. Jr.; Dunn, B. M. (Babcock and Wilcox Co., Lynchburg, Va. (USA)). Jul 1975. 9p. Babcock and Wilcox, Lynchburg, VA.

The effectiveness of the ECCS for B and W's 205-fuel assembly plants is evaluated and shown to meet all the requirements of 10 CFR 50.46. The results of various sensitivity studies, a spectrum of breaks, and an analysis to determine allowable linear heat rates under 10 CFR 50.46 are presented. (auth)

16216 (BAW-10104) B AND W's ECCS EVALUATION MODEL. Dunn, B. M.; Jones, R. C.; Cartin, L. R.; Parks, C. E.; Salm, R. J. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). May 1975. 109p. Babcock and Wilcox, Lynchburg, VA.

The generic model for evaluating the performance of emergency core cooling systems following a loss-of-coolant accident for all B and W NSSs is developed and compared with the required and acceptable features contained in Appendix K of the Code of Federal Regulations, 10 CFR 50. Both the large- and small-break evaluation models are presented and are shown to conform to Appendix K. 29 references. (auth)

16217 (JEN-298) INFORMATION TO BE REQUESTED FROM THE NSSS VENDOR FOR FUEL MANAGEMENT CAPABILITY FOR PWR. Minguez, E.; Anhert, C.; Aragones, J. M.; Esteban, A.; Gomez, M.; Leira, G.; Martinez, R. (Junta de Energia Nuclear, Madrid (Spain)). 1975. 22p. (In Spanish). Dep. NTIS (US Sales Only) $4.25.

A set of the nuclear, thermal-hydraulic, and mechanical parameters is listed; these data are the main parameters for the design of the latest PWR's. They are necessary to perform the fuel management and must be supplied by the reactor manufacturer to the utility. (auth)

16218 (ORNL-SUB-3310-4) TEST REPORT ON EXPERIMENTAL STRESS ANALYSIS OF A 24 INCH DIAMETER TEE (ORNL T-12). Henley, D. R. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA). Nuclear Components Dept.). Apr 1975. 233p. (CENC-1237). Dep. NTIS $14.75.

For Oak Ridge National Lab., TN.

The experimental stress analysis and low cycle fatigue test of one 24" x 24" x 10" schedule 40 carbon steel, ANSI B16.9 tee performed by Combustion Engineering, Inc. is described. The tee was instrumented with 230 rectangular strain gage rosettes. Elastic data was obtained for 12 loading conditions consisting of internal pressure and orthogonal pure moments and orthogonal direct forces applied individually to the free branch and run ends of the tee. One of the run ends of the tee was "built in" throughout the test. All loads were applied through pipe extensions welded to the tee. The tee was tested to failure in a low cycle pressure fatigue test with a cyclic internal pressure between 0 psi and 1800 psi. A through-the-wall fatigue crack occurred at 76620 cycles. Significant test results are summarized and compared with design values tabulated in the ASME Boiler and Pressure Vessel Code, Section III, 1971. (auth)

16219 (WAPD-TM-996) WHIP-1: A FORTRAN-IV PROGRAM TO ANALYZE STRUCTURAL DEFLECTION DUE TO BLOWDOWN FORCES. Murphy, J. H. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Apr 1975. Contract AT(36-1)-GEN-14. 21p. Dep. NTIS $4.25.

The program calculates the dynamic behavior of a pipe or membrane under the influences of an externally applied force, taking into account the elastic-plastic properties and the inertia of the member. 3 references. (auth)

16220 (WCAP-8517) UHI PLANT INTERNALS VIBRATION MEASUREMENT PROGRAM AND PRE AND POST HOT FUNCTIONAL EXAMINATIONS. Bloyd, C. N.; Singleton, N. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Energy Systems Div.). Mar 1975. vp. Westinghouse Corp., Pittsburgh.

A test program designed to confirm the adequacy of the four-loop, 17 x 17 Upper Head Injection upper internals assembly is described. The program, to be carried out at the TVA Sequoyah No. 1 plant, consists of pre and post hot functional visual examinations and measurement of internal vibration by transducers mounted on the reactor upper internals. The background tests and analyses which led to the proposed program are discussed, and the selection of components to be instrumented is justified. (auth)

16221 ALBEDO-ADJUSTED FAST-NEUTRON DIFFUSION COEFFICIENTS IN REACTOR REFLECTORS. Terney, W. B. (Combustion Engineering, Inc., Windsor, CT). Nucl. Sci. Eng.; 57: No. 3, 239-245(Jul 1975).

In the newer, larger pressurized-w' .er reactor cores, the calculated power distributions are fa' ly sensitive to the number of neutron groups used and to the tr .tment of the reflector cross sections. Comparisons between transport and diffusion calculations show that the latter substantially underpredict the reflector albedos in the fast (top) group and that the power distribution is shifted toward the core center when compared to 4-group transport theory results. When the fast-neutron diffusion coefficients are altered to make the transport- and diffusion-theory albedos agree, the power distributions are also brought into agreement. An expression for the fast-neutron diffusion coefficients in reflector regions has been derived such that the diffusion calculation reproduces the albedo obtained from a transport solution. In addition, a correction factor for mesh effects applicable to coarse mesh problems is presented. The use of the formalism gives the correct albedos and improved power distributions. (auth)

16222 WATER CHEMISTRY AND CORROSION LIMITATION IN THE BBR-STEAM GENERATOR SYSTEM. Ernstberger, R. (Babcock–Brown Boveri Reaktor G.m.b.H., Mannheim (F. R. Germany)); Pocock, F. J. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research and Development Div.). pp 268-272 of Reports: Power Plants 1974. Essen, F. R. Germany; VGB-Dampftechnik (1974). (In German)

From congress power plants 1974. Annual meeting of the VGB; Dortmund, F. R. Germany (9 Jul 1974). 8 figs.; 7 tabs. With abstract.

The BBR-steam generator system comprises a light water cooled and moderated pressurized water reactor with boron trimming and two straight-tube steam generators. Following an introductory description of the system, the chemical conditioning of the water is examined. The straight-tube steam generator is compared to the natural-circulation boiler and the differences in water chemistry and operation are discussed. Basic results from laboratory investigations for this type of plant are also mentioned: Choice of suitable pH additive for the primary water; solubility of salts in superheated steam; and resistivity of Inconel 600 under steam generator operational conditions. Operational data from the first prototype plant straight-tube equipped steam generator Oconee 1 are used for comparison. (GE)

16223 THE SAFETY IN STEAM GENERATOR OPERATION IN PRESSURIZED WATER REACTORS. Styrikowitsch, M. A.;

Margulowa, T. C. (AN SSSR, Moscow; Moskovskij Ehnergeticheskij Inst. (USSR)). Arch. Energiewirtsch.; 29: No. 2, 119-124 (Feb 1975). (In German).

5 figs.; 4 refs. Translated from Teploehnergetika v. 21(9), 1974, p. 55-57.

The construction characteristics of Soviet and American steam generators in pressurized water reactors are compared. The operational disadvantages of the constructions (deposits, cracking and corrosion of the steam generator tubes, and the blow-out methods for tube cleaning) are described. (GE)

16224 IMPORTANCE OF THERMOHYDRAULIC CONDITIONS FOR CORROSION SAFETY OF PWR-STEAM GENERATORS. Guelich, J. F. (Sulzer Bros. Ltd., Winterthur (Switzerland)). Atomwirtsch., Atomtech.; 20: No. 2, 82-87(Feb 1975). (In German).

In different nuclear power plants with pressurized water reactors, leakages caused by local corrosion appeared at the steam generators. While constructors and operators are concentrating their main attention on the influencing parameters such as feedwater chemistry and tube material, the present study shows that damage always appeared in regions of less defined streaming conditions. The study leads to the result that local drying out of heating surface may be one reason for the damage. As a measure against corrosion damage, it is suggested to avoid the gap between the tubing disc and the tube itself, to improve the streaming conditions at the inlet of the bundle, to construct the tube mounting in such a way that the tubes can easily be streamed around, to keep the number of turns as high as possible so that the steam content at the bundle outlet is as low as possible, to place the purifying system into the pressure region, and to improve the chemical conditions as well as the condensate purity. (auth)

16225 RADIOACTIVE CONTAMINATION IN PWR PRIMARY CIRCUITS. Frejaville, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France). Dept. de Physique des Reacteurs et Mathematiques Appliquees); Beslu, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees); Marchal, A. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, 08 - Chooz-lez-Givet (France)); Samuel, T. (Nordostschweizerische Kraftwerke A. G., Doettingen. Kernkraftwerk Beznau). pp 77-78 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Since 1971, the corrosion product activity has been monitored in the coolant and on the out-of-core surfaces of the primary circuit at Beznau and at the Centrale des Ardennes. In order to extrapolate the results either to subsequent cycles of operation of these reactors or to other PWR reactors, a physical model accounting for all corrosion product movement inside the primary circuit was developed. The results obtained were used as the basis for the Pactole computer code. (FR)

16226 THE APPLICATION OF THE FRACTURE MECHANICS TO PWR VESSELS. Pellissier-Tanon, A.; Vagner, J.; Devaux, J. C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). pp 38-39 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The methods actually used by Framatome are presented and a justification is given for the application of these methods. The following topics are discussed: general justification for the use of linear elastic fracture mechanics for the analysis of vessels; sizes of the flaws introduced in the analysis; choice of a criterion for the fast fracture; presentation and justification of the different methods. (FR)

16227 HEALTH PHYSICS DURING THE FIRST GENERAL INSPECTION OF ARDENNES NUCLEAR POWER PLANT. Martin, J. J. (Electricite de France, 93 - Saint-Denis. Dept. de Radioprotection); Riehl, R. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, 08 - Chooz-lez-Givet (France)). pp 69-70 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The Ardennes Nuclear Power Plant is the first pressurized water reactor in operation in France. In 1974, during reactor shutdown in view of refueling, the reactor vessel, main primary ducts and boilers were inspected. The material and personnel organization is described together with some particular work on specific health physics problems. A balance of the observed external exposure and internal contamination among the workers is reported. (FR)

16228 NUCLEAR REACTOR CORE. Barry, R. F. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,213,560/A/. 4 Jan 1974. 15p. (In French).

16229 DESIGN DIFFERENCES BETWEEN FRAMATOME AND WESTINGHOUSE PWR POWER PLANTS. Py, J. P. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). pp 17-18 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Modifications brought to PWR power plants built by Framatome because of the French electric network frequency are described: design of primary pumps, steam generators and reactors internals. Other improvements were made, in particular to in-core instrumentation design. Safety systems were reinforced. (FR)

16230 SMALL AND AVERAGE POWER NUCLEAR BOILERS TO PRODUCE ELECTRICITY OR BOTH STEAM/ELECTRICITY. Martinot, G.; Porte, P.; Sautiez, B. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). pp 18-23 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Original techniques developed for small and average power nuclear plants 120 to 1200 MW(t) by Technicatome Co. (France) from CEA-developed naval propulsion PWR reactors are presented. Economic performance of such types of unit compared to the boiler fuel and electricity solution, in particular for seawater desalination plants, is analyzed. Industrial development potential and market are studied. (FR)

16231 PWR FUEL OPERATING EXPERIENCE AND PERFORMANCE EVALUATION PROGRAM. Traccucci, R. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). pp 100-102 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The Westinghouse fuel operating experience accumulated up to now is reviewed. This has shown good performance in general, however, a small percentage of fuel elements has been defective. A description of the main observed defects and their respective remedies are presented: internal hydriding, fretting corrosion on peripheral fuel assemblies, densification, fuel rod deformation. A description of the fuel performance evaluation program is included. (FR)

16232 SYSTEM 80: COMBUSTION ENGINEERING'S STANDARD 3800-MWt PWR. Bevilacqua, F.; Gibbons, J. F. (Combustion Engineering, Inc., Windsor, CT). Proc. Am. Power Conf.; 36: 70-97(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the specifications for the System 80 plant layout, steam generators, reactor coolant pumps, pressurizer, pressure vessel, reactor arrangement, upper guide structure, fuel elements and control rods, instrumentation and control, plant protective system, computer system, refueling system, and ECCS. (8 references) (DCC)

16233 WESTINGHOUSE 3817-MWt NSSS. Toth, G. P.; Nath, R. J. (Westinghouse Electric Corporation, Pittsburgh). Proc. Am. Power Conf.; 36: 98-106(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the specifications for the 3817 MW(t) NSSS reactor internals, primary coolant circuits, rapid refueling system, and fluid systems. Testing programs and licensability of the reactor are analyzed. (DCC)

16234 ONCE-THROUGH PERFORMANCE AT 3800 MWt: THE BABCOCK-241 STANDARDIZED NUCLEAR STEAM SYSTEM. MacMillan, J. H.; Johnson, T. O. (Babcock and Wilcox Co., Lynchburg, VA). Proc. Am. Power Conf.; 36: 117-124(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the specifications for the Babcock 241 reactor core, primary coolant circuit, steam generators, ECCS, instrumentation, and control system. (DCC)

16235 STARTUP AND INITIAL OPERATION OF OCONEE UNITS 1 AND 2. Owen, W. H. (Duke Power Co., Charlotte, NC); Parker, W. O.; Deddens, J. C.; Kulynych, G. E. Proc. Am. Power Conf.; 36: 135-142(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the hot functional testing, initial fuel loading, zero power physics testing, and power escalation test sequence. (DCC)

16236 NORTHERN STATES POWER PRAIRIE ISLAND STARTUP ORGANIZATION. Matheny, R. A. (Westinghouse Electric Corp., Pittsburgh); Leddick, R. S. Proc. Am. Power Conf.; 36: 163-169(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

16237 DEVELOPMENT OF A NUCLEAR FUEL ASSEMBLY FOR IMPROVED SAFETY MARGIN. McGrath, R. G.; Roll, J. B. (Westinghouse Electric Corp., Pittsburgh). Proc. Am. Power Conf.; 36: 259-273(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

The concept selection, the project control, and the engineering and development programs which have led to the design confirmation of the 17 x 17 fuel assembly concept for PWR type reactors are described. (auth)

16238 WATER CHEMISTRY EXPERIENCE AT THE OCONEE NUCLEAR PLANT. Haller, W. A. (Duke Power Co., Charlotte, NC); Pocock, F. J. Proc. Am. Power Conf.; 36: 772-783(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 16282, 16535, 16537, 16553, 16561, 16659, and 16672.

16239 (AED-CONF-75-023-011) BEHAVIOUR OF THE HIGH-TEMPERATURE REACTOR FOR DIFFERENT FUEL CYCLES. Teuchert, E.; Brandes, S. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). 1975. 24p. (In German). INIS.

From KTG-special meeting 'long-term behaviour'; Stuttgart, F. R. Germany (25 Feb 1975).

3 figs.; 7 tabs.; 10 refs.

High temperature reactor operation is possible with the following fuel cycles: (1) In the uranium cycle uranium with a modest enrichment of 6 to 12% is used and a burnup of 70,000 to 130,000 MWd/t is reached. (2) In the thorium cycle 93% enriched uranium is used together with ^{232}Th as breeding material. The amount of fissionable materials and the mean burnup attainable is comparable with the values in the uranium cycle. The uranium 233 is bred in relatively large amounts. (3) A variant of the thorium cycle is the High-Converter, in which the conversion rate is raised up to values from 0.85 to 0.95. (4) A fourth possible fuel cycle is based on the utilization of plutonium as fissionable material. It can be used as well in connection with thorium as in the uranium cycle. (GE)

16240 (GA-A-13281) COMPONENT AND SYSTEMS DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending December 30, 1974. (General Atomic Co., San Diego, Calif. (USA)). 14 Feb 1975. Contract AT(04-3)-167. 28p. Dep. NTIS $4.00.

Information is presented concerning fatigue and creep–fatigue studies on HTGR materials, helium effects studies, and the development of the thermal barrier for the reactor pressure vessel. (DCC)

16241 (GA-A-13282) FORT ST. VRAIN SURVEILLANCE AND TESTING PROGRAM. Quarterly Progress Report for the Period October 1, 1974–December 31, 1974. (General Atomic Co., San Diego, Calif. (USA)). 15 Jan 1975. Contract AT(04-3)-167. 4p. Dep. NTIS $4.00.

16242 (GA-A-13411) COMPONENT AND SYSTEMS DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1975. Contract AT(04-3)-167. 55p. Dep. NTIS $5.45.

Information is presented concerning fatigue and creep–fatigue studies on HTGR materials, helium effects studies, and the vibration testing of the thermal barrier for the reactor pressure vessel. (DCC)

16243 (GERHTR-94) CHANGES INDUCED BY THE FAST NEUTRON FLUX IN THE MECHANICAL BEHAVIOR OF COATED PARTICLES IN THE HIGH TEMPERATURE REACTOR (HTR). Baier, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Jan 1974. Translation of JUL-1038-HT. 188p. Dep. NTIS $7.60.

Thesis. Work performed under United States–German High Temperature Reactor Research Exchange Program.

Fast neutron dose limits are described beyond which mechanical failure of pyrocarbon layers occurs with coated particle fuel. The influence of irradiation temperature, layer geometry and structural parameters in the pyrocarbon on the lifetime of the particles is described. In the experiments a fast neutron dose of more than 20×10^{21} cm^{-2}, E > 0.1 MeV, had been accumulated with temperatures ranging from 600 to 1300°C. The most determining factor on the lifetime of particle coatings is the PyC structure which, however, cannot sufficiently be described by the parameters generally used: density, apparent crystallite size and anisotropy of orientation. Additional detailed information on manufacture therefore is essential. (89 references) (auth)

16244 (NP-20456, pp vp Paper 10) CONTROL OF RADIONUCLIDE RELEASES FROM GAS-COOLED REACTORS. Goodjohn, A. J. (General Atomic Co., San Diego, CA). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Design characteristics of HTGR type reactors are presented. The reactor containment system, helium purification system, and radioactive gas waste system are described. (DCC)

16245 (ORNL-TM-4802) MOLTEN-SALT REACTOR INFORMATION SYSTEM. Haubenreich, P. N.; Cardwell, D. W.; Engel, J. R. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 60p. Dep. NTIS $5.45.

The Molten-Salt Reactor Information System (MSRIS) is a computer-based file of abstracts of documents dealing with the technology of molten-salt reactors. The file is stored in the IBM-360 system at ORNL, and may be searched through the use of established interactive computer programs from remote terminals connected to the computer via telephone lines. The system currently contains 373 entries and is subject to updating and expansion as additional information is developed. The nature and general content of the data file, a general approach for obtaining information from it, and the manner in which material is added to the file are described. Appendixes provide the list of keywords currently in use, the subject categories under which information is filed, and simplified procedures for searching the file from remote terminals. (auth)

16246 (TGR-Report-2640(R)) BLOC: A COMPUTER PROGRAM FOR CALCULATING AXIAL STRESSES IN HTR FUEL BLOCKS. Rossiter, F. (UKAEA Reactor Group, Risley). Jan 1975. 16p. Dep. NTIS (US Sales Only) $4.00. UK HMSO 50 pence.

BLOC is a computer program in BASIC language for the determination of axial thermal and shrinkage stresses in graphite bodies such as HTR fuel elements which experience differential temperatures and fast neutron irradiation. Since the axial stresses are generally greater than the transverse, they are of primary interest to the designer and by calculating these alone, BLOC is able to operate with considerably simplified input and thus enables inexpensive and rapid results to be obtained, particularly if an interactive computer terminal is used. A consequence of this simplification is a reduced accuracy in the results compared to those programs which estimate stresses in three axes. (auth)

16247 NUCLEAR REACTORS AND CLOSURE ARRANGEMENTS FOR USE THEREIN. Burylo, P. S.; Hughes, D. J. (to English Electric Co. Ltd.) US Patent 3,883,392. 13 May 1975. Filed date 6 Dec 1972. 6p.

A nuclear reactor is described in which a penetration which houses a heat exchanger of the turbomachinery in the pressure wall of the reactor is closed by a primary closure device which provides a gastight seal across the penetration, and a secondary closure device to limit the escape of gas from the penetration on failure of the primary closure device, wherein the secondary closure device is provided by a waterbox of the heat exchanger. The secondary closure device may have projections engageable with retaining projections of the penetration, the closure device being fitted in position by axial movement followed by a partial rotation to bring the co-operating surfaces of the closure device projections and the retaining projections into engagement. (Official Gazette)

16248 NEW PROSPECTS FOR THE COAL GASIFICATION. Peters, W.; Schilling, H. D. Glueckauf.; 110: No. 22, 927-935 (Nov 1974). (In German).

Following a review on the present energy situation, an introduction into the fundamentals of coal gasification is given. Furthermore, the operational aspects of various gasification methods

are described with special regard to the application possibilities of the gasification products. The use of a pressure gasification installation primary to the pit-coal power station as well as the gasification of coal by heat from high temperature reactors serve as an example for new activities. (GE)

16249 MOLTEN SALT REACTORS. Faugeras, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Actual. Chim.; No. 2, 14-21(Feb 1975). (In French).

The problems of molten salt chemistry are discussed with respect to materials (corrosion) and the continuous purification of the salt. The fuel salts used are uranium, plutonium and thorium fluorides mixed with other fluorides in the case of thermal reactors and mixtures of uranium-plutonium chlorides with other chlorides in the case of fast reactors. Processes of continuous treatment of these salts to eliminate the absorbing fission products are suggested. These are essentially systems using uranium and plutonium volatilization as hexafluorides and the counter current exchanges between a saline phase and a metallic phase. (FR)

16250 STUDY OF HIGH-TEMPERATURE REACTOR FUEL CYCLES. Brisbois, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques); Couture, J. (CEA Direction des Productions, 92 - Chatillon (France). Sous-Direction du Plutonium); Roudier, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires); Sartorius, R. (CEA, 75 - Paris (France)). pp 160-162 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

A comparison is established between the highly enriched uranium and thorium cycle and the low enriched uranium cycle used in a 1160MW(e) reactor with the same type of fuel elements as the General Atomic integrated block. In the case of the thorium cycle, the ^{233}U produced is recycled in the reactor. For the low enriched uranium cycle, the plutonium produced is sold, together with the ^{231}U withdrawn from the reactor. (FR)

16251 HELIUM ISOTOPIC COMPOSITION AND METHOD OF PREPARATION. Garwin, L. French Patent 2,207,087/A/. 16 Nov 1973. 18p. (In French).

16252 NUCLEAR REACTOR. (to English Electric Co. Ltd., Whetstone (UK)). French Patent 2,209,982/A/. 8 Dec 1972. 15p. (In French).

16253 OPERATION CAPABILITY OF STANDARD HTR FUEL AT HIGH TEMPERATURE. Gaube, M.; Aerts, L.; Thomson, J. M. (Societe Belge pour l'Industrie Nucleaire, Brussels); Vangeel, J.; Van de Velde, J.; Van Loon, C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). pp 102-105 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

An important program of particle, compact, and fuel element irradiation was started in 1965. Post irradiation examinations of these experiments allowed the effects of the high temperatures and high temperature gradients on the fuel to be investigated. (FR)

16254 GENERAL ATOMIC'S 1500-MWe HIGH-TEMPERATURE GAS-COOLED REACTOR. Waage, J. M.; Goodjohn, A. J.; Crimmins, D. H.; Wessman, G. L. (General Atomic Co., San Diego, CA). Proc. Am. Power Conf.; 36: 125-134(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the specifications for the plant layout, nuclear steam supply system, core and major components, prestressed concrete pressure vessel, control system, and safety systems. (DCC)

16255 PLANT COMPLETION, FUEL LOADING, TESTING, AND STARTUP AT THE FORT ST. VRAIN NUCLEAR GENERATING STATION. Swart, F. E. (Public Service Co. of Colorado, Platteville); Block, G. A.; Simon, W. A. Proc. Am. Power Conf.; 36: 151-162(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

16256 TURBINE-GENERATOR CONTROL SYSTEMS FOR DUAL UNITS IN NUCLEAR APPLICATIONS. Jaegtnes, K. O. (Westinghouse Electric Corp., Philadelphia); McDonald, J. P.; Broer, W. T. F. Proc. Am. Power Conf.; 36: 522-527(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

16257 TECHNICAL AND ECONOMIC SITUATION OF THE HYDROGEN PREPARATION BY HYDROGASIFICATION OF COAL FOLLOWED BY METHANE CRACKING UNDER CHARGE OF NUCLEAR REACTOR HEAT AND SIMULTANEOUS GENERATION OF ELECTRICITY. Toelle, R. Aachen; Technische Univ. (1973). 87p. (In German). INIS.

Thesis.

An evaluation is given of the production cost of hydrogen produced in hydrogasification followed by allothermal methane cracking. The required reaction heat is supplied by a helium-cooled, high-temperature nuclear reactor with spherical fuel elements. The waste heat is transformed into electricity by a helium turbine. Gas composition and gas flow are computed with the assumption that all reactions except the methane formation reaction reach chemical equilibrium. Plants in which gas separation is carried out after gasification and only methane is used for steam reforming have a higher rentability than plants in which the gaseous products from the gasifier are directly introduced to the steam reformer and in which the gas separation is carried out later. (GE)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 13841.

16258 (EP-74-R-34, pp 1-29) STRESS ANALYSIS AND THE FUTURE OF NUCLEAR POWER. Perryman, E. C. W. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

The direction of evolution of the CANDU type reactor over the next 10 or 20 years is predicted. The applications of stress analysis to improvements in design of pressure tubes, end fittings, tubesheets, pressure vessels, and problems in quality control, mechanical components, and fuel design are described. (CA)

16259 (ORNL-TM-1365) DESIGN STUDY OF BOILING POTASSIUM REACTORS FOR THERMAL OUTPUTS OF 1 Mw TO 30 Mw. Fraas, A. P.; Perry, A. M.; Michel, J. W.; Smith, O. L.; Wilson, J. V. (Oak Ridge National Lab., Tenn. (USA)). Apr 1966. Contract W-7405-eng-26. 73p. Dep. NTIS $6.75.

Declassified 4 Sep 1973.

A preliminary design study of boiling potassium reactors for thermal outputs in the range from 1 MW to 30 MW was made to assess the scale-up potential of the boiling potassium cooled reactors similar to the MPRE type of space power system. Consideration of the materials, heat transfer, fluid flow, and reactor physics aspects indicate that there should be no major scale-up problems. The primary design limitation for a reactor designed for an equivalent full power life of 15,000 hr is the radiation damage to the materials of construction and the effects of fuel burnup rather than the heat transfer capabilities. One of the consequences of this limitation was that MgO was substituted for BeO in the reflector, and this was shown to be an acceptable change. 30 references. (auth)

16260 SOME PROBLEMS CONCERNED WITH OBSERVING LIMITS AND CONDITIONS DURING THE COMMISSIONING OF THE A-1 NUCLEAR POWER PLANT. Paulicka, I. (Bohunice Nuclear Power Plant, Czech.). pp 221-228 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Radiation safety limits and conditions for the normal operation of the Bohunice A–1 Reactor are described. Radiation releases during accident conditions are discussed. 8 references. (DCC)

Power Reactors, Breeding

Refer also to abstracts 16528, 16529, 16533, 16534, 16544, 16546, 16547, 16552, 16555, 16561, 16563, 16570, 16638, 16659, and 16672.

16261 (ANL-AFP-9) CHEMICAL COMPATIBILITY BETWEEN CLADDING ALLOYS AND ADVANCED FUELS. Fee, D. C.; Johnson, C. E. (Argonne National Lab., Ill. (USA)). May 1975. Contract W-31-109-Eng-38. 18p Dep. NTIS $4.00.

The National Advanced Fuels Program requires chemical, mechanical, and thermophysical properties data for cladding alloys. The compatibility behavior of cladding alloys with advanced fuels is critically reviewed. In carbide fuel pins, the principal compatibility problem is cladding carburization, diffusion of car-

bon into the cladding matrix accompanied by carbide precipitation. Carburization changes the mechanical properties of the cladding alloy. The extent of carburization increases in sodium (versus gas) bonded fuels. The depth of carburization increases with increasing sesquicarbide (M_2C_3) content of the fuel. In nitride fuel pins, the principal compatibility problem is cladding nitriding, diffusion of nitrogen into the cladding matrix accompanied by nitride precipitation. Nitriding changes the mechanical properties of the cladding alloy. In both carbide and nitride fuel pins, fission products do not migrate appreciably to the cladding and do not appear to contribute to cladding attack. (77 references) (auth)

16262 (ANL-RDP-39) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, APRIL 1975. (Argonne National Lab., Ill. (USA)). 6 Jun 1975. Contract W-31-109-Eng-38. vp. AT.

Progress is reported in the following areas: EBR-2 operation and testing; UMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and GCFR studies. (DCC)

16263 (BNWL-SA-5310) CRITICALITY IMPLICATIONS OF Pu–U CARBIDE AND Pu–U NITRIDE FUEL MIXTURES. Bierman, S. R.; Howes, B. W.; Clayton, E. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 13p. (CONF-750607-16). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Two candidate fuels for LMFBR's consist of mixtures of either plutonium-uranium monocarbides or plutonium-uranium mononitrides. No experimental criticality data as yet exists for either fuel that is appropriate to the fuel cycle operations outside reactors. To provide the necessary insight needed for selecting and planning experiments, and to provide the interim guidance needed in the development of the carbide and nitride fuels, a series of survey calculations were made. The calculations were made with ENDF/B-3 cross section data which were processed by the computer codes ETOG and FLANGE and averaged over 17 epithermal energy groups and one thermal energy group (0 – 0.683 eV) by the code EGGNIT for use in either the neutron diffusion theory code HFN or the neutron transport theory code DTF-IV. The critical sizes for the homogeneous systems having concentrations below about 400 g Pu + U/liter were calculated by HFN. DTF-IV was used for concentrations above about 800 g Pu + U/liter. The calculations encompassed homogeneous mixtures in spherical and cylindrical geometries containing 15 and 30 wt percent plutonium in the Pu + U. The results of these calculations are tabulated and compared with data on mixed oxides. (auth)

16264 (CEA-CONF-2931) REACTIVITY METERS FOR MEASUREMENT, COMMAND AND SAFETY, PERIOD METERS, DOUBLING TIME METERS. Plaige, Y.; Tournier, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France) Services d'Electronique). 14 Nov 1974. 16p. (In French). (CEA-SES-PUB-SAI-74-239). INIS.

From one-day meeting on the electronic instrumentation for nuclear reactor control; Paris, France (18 Dec 1974).

Reactimeters are now commonly used in fast reactor protection systems. The working principles of these instruments are outlined and the various types of reactimeter in existence or under development, together with applications foreseen in the measurement, piloting or safety fields, are reviewed. These instruments are compared with periodmeters and doubling-time meters and their mutual advantages and disadvantages are discussed. (FR)

16265 (COO-2467-2) THREE-DIMENSIONAL LMFBR SHIELDING DESIGN AND ANALYSIS CODE. Quarterly Progress Report, 1 December 1974–28 February 1975. Poncelet, C. G.; Bucholz, J. A. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Nuclear Engineering). 1975. Contract At(11-1)-2467. 71p. (CMU-NE-202). Dep. NTIS $6.75.

Preliminary evaluations and testing of the Direct-Coupled Ray (DCR) method as a three-dimensional industrial design tool for LMFBR shielding calculations are described. Selected problem configurations and multigroup neutron cross section data for testing and evaluation of the method as implemented in the TRANS3 code are described. The problem configurations are based on various representations of the lower axial shield region of the Clinch River Breeder Reactor. Monoenergetic TRANS3 calculations of single region deep penetration problems and multigroup TRANS3 calculations of one-dimensional representations of the CRBR lower axial shield region are compared with corresponding discrete ordinates ANISN calculations. The agreement between the two computational methods is generally very good over several orders of attenuation. 9 references. (auth)

16266 (EIR-277) PLUTONIUM FUEL PROGRAM ANNUAL REPORT, 1974. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1975. 95p. (In German). Dep. NTIS (US Sales Only) $7.75.

The development, fabrication, and irradiation testing results of sphere-pac PuC–UC fuel pins for LMFBR type reactors are presented. 37 references. (DCC)

16267 (EURFNR-1248) MOTIVATIONS AND PERFORMANCES OF CARBIDE FUEL DEVELOPMENT. Karsten, G.; Muehling, G.; Plitz, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter). Oct 1974. 17p. (CONF-741017-36; KFK-2111). Dep. NTIS (US Sales Only) $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

Work performed under United States–Euratom Fast Reactor Exchange Program.

The fuel element concept foresees a linear rating of 800 W/cm, a pin diameter of approximately 8mm with helium bonded pins. Because of restrictions by clad material swelling the maximum neutron dose of about 1.5×10^{23} n/cm^2 > 0.1 MeV will limit the maximum nominal target burnup in the range of 60–90.000 MWd/tm. Up to now these burnups have been reached within this program without indication of principal difficulties, even under conditions of higher fuel swelling and mechanical interactions with the cladding. Therefore the present design seems to be capable to meet the target conditions. (auth)

16268 (GEAP-14031-2) CORE RESTRAINT ENGINEERING SECOND QUARTERLY REPORT, NOVEMBER–JANUARY 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Feb 1975. Contract AT(04-3)-893. 12p. AT.

Core restraint system design requirements, subcomponents, and analytical methods in accordance with LMFBR Program Plant Task 6-216-1, 6-216-2, and 6-216-3 are presented. Progress during November, December 1974 and January 1975 is described for subtasks related to withdrawal force testing, transient analysis, load pad and channel wall lateral limits, in-reactor load pad surveillance, and withdrawal force minimizer. (auth)

16269 (HEDL-TME-74-55) SIEX: A CORRELATED CODE FOR THE PREDICTION OF LIQUID METAL FAST BREEDER REACTOR (LMFBR) FUEL THERMAL PERFORMANCE. Dutt, D. S.; Baker, R. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 72p. Dep. NTIS $5.45.

The SIEX computer program is a steady state heat transfer code developed to provide thermal performance calculations for a mixed-oxide fuel element in a fast neutron environment. Fuel restructuring, fuel-cladding heat conduction and fission gas release are modeled to provide assessment of the temperatures. Modeling emphasis has been placed on correlations to measurable quantities from EBR-II irradiation tests and the inclusion of these correlations in a physically based computational scheme. SIEX is completely modular in construction allowing the user options for material properties and correlated models. Required code input is limited to geometric and environmental parameters, with a "consistent" set of material properties and correlated models provided by the code. 24 references. (auth)

16270 (HEDL-TME-75-21) HIGH TEMPERATURE ULTRASONIC TRANSDUCERS FOR IN-SODIUM SERVICE. Smith, R. W.; Day, C. K. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-2170. 55p. AT.

Ultrasonic transducers developed for use in the optically opaque, high radiation environment of Liquid Metal Breeder Reactors (LMFBR) can be applied to measure, inspect and visualize the internal LMFBR components. The transducer described was developed for imaging and ranging applications in liquid sodium during reactor shutdown. The operating temperature limit is about 560°F, the nominal melting temperature of the bonding alloy used to fasten the peizoelectric active element into the stainless steel case. A number of transducers have been successfully operated for several hundred hours in 500°F liquid sodium. The transducer, the fabrication process, and some of the reactor applications are described. (auth)

16271 (HEDL-TME-75-39) SIMULATION OF COOLANT TRANSPORT AND HEAT EXCHANGE IN PIPE RUNS. Johnson, H. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. 100p. Dep. NTIS $5.45.

Pipe runs for sodium coolant systems are satisfactorily simulated by simplified models with no more than 24 axial by 3 radial nodes, consisting of coolant, pipe wall and ambient nodal points. Heat losses from the insulated pipe to its surroundings are included by a constant heat transfer resistance from the pipe's outside surface to the ambient. The best accuracy for simplified models is obtained by simulating the delta T/delta X derivative by three-point difference approximations. An explicit numerical integration method is used with these simplified models. The simplified models are checked against detailed 48 axial by 5 or 8 radial node reference models, which use a four-point Adams-

Moulton predictor-corrector numerical integration method. A generalized computer program, which is based on the selected simplified model, has been written for incorporation as a subroutine in reactor/heat transport system simulation codes. (5 references) (auth)

16272 (IEA-354) EVALUATION OF FAST REACTOR BLANKETS. Oosterkamp, W. J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Sep 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

A comparative study of different types of fast reactor radial blankets is presented. Included are blankets of fertile material UO_2, ThO_2 and Th metal blankets of pure reflectors C, BeO, Ni and combinations of reflecting and fertile blankets. The most favorable fertile material is thorium due to the prospective higher price of U 233. 10 references. (auth)

16273 (JAPFNR-186) SODIUM TECHNOLOGY. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Oct 1974. 109p. (N-251-74-10). Dep. NTIS (US Sales Only) $5.45.

Work performed under United States–Japanese Fast Reactor Exchange Program.

Sodium is the most promising coolant for the fast breeder reactor with its good nuclear and heat transfer properties and economical advantage; however, its chemical activity poses many problems. The development of sodium technology, therefore, is urgently needed for the progress of the sodium-cooled fast breeder reactor project. The present status, problems awaiting solution, and the plan for future R and D of sodium technology are described, intending that engineers in Japan would pay more attention to the sodium technology essential to fast breeder reactor development. The following are treated: physical properties, structural materials (mechanical properties and sodium compatibility), flow and heat transfer, chemical analysis, purity control, FBR plant components, instrumentation, loop facilities, loop operation, and list of sodium test loops in the world. (auth)

16274 (ORNL-TM-4108) HEAT TRANSFER TESTS OF RIBBED SURFACES FOR GAS-COOLED REACTORS. Klepper, O. H. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 61p. Dep. NTIS $5.45.

The performance of gas-cooled reactors is often limited by the heat transfer in the reactor core. Means for modifying core heat transfer surfaces to improve their performance were investigated. The 0.3-in.-OD stainless steel clad heater rods were photo-etched to produce external ribs 0.006 in. high and 0.12 in. wide with a pitch of 0.072 in. Helical ribs with a helix angle of 37° (to promote interchannel flow mixing in a multirod array) were provided on one surface. For comparison purposes, a transversely ribbed surface and a smooth rod were also studied. The test surfaces were 49 in. long with a 24-in. heated region, concentrically arranged inside a smooth 0.602-in.-ID stainless steel tube. Nitrogen gas at pressures up to 400 psig was used as the coolant; the linear heat rating ranged to 6.8 kW/ft at surface temperatures up to 1400°F; T/sub w//T/sub b/ varied from 1.2 to 2.4 at Re values up to 450,000. Annulus results were recalculated for rod geometry using two different transformations. Good agreement was observed with applicable literature values. The effectiveness of the surfaces was assessed as the ratio E of the heat transfer coefficients of the roughened rods to that of a smooth rod at the same pumping power. The effectiveness of the spiral ribs ranged from 1.3 to 1.4, and from 1.2 to 1.4 for the transverse ribs, spanning Re values from 60,000 to 400,000. These data include variations introduced by alternate transformation methods that were used to make annulus test results applicable to rod geometry. The surfaces investigated in these tests were considered for fast gas-cooled reactors; however, the range of parameters studied also applies to heat transfer from ribbed rod-type fuel elements in thermal gas-cooled reactors. (auth)

16275 (RCN-225) FAST REACTOR PROGRAM. Fourth Quarter 1974 Progress Report. Hoekstra, E. K. (comp.). (Stichting Reactor Centrum Nederland, Petten). Apr 1975. 89p. Dep. NTIS (US Sales Only) $7.50.

The final corrected time-of-flight oscillator spectra of the STEK cores 500, 1000, 2000, 3000 and 4000 are given. Results of post-irradiation examinations of the three fuel pins R54-F24, F30 and F34 and initial observations on the in-pile loss-of-cooling experiment R63-L12 are discussed. Further attempts to prepare UC powders of low oxygen content and with a large surface area are described. The continued research on the thermodynamic stability of cesium uranates is reported. Results of creep and low-cycle-fatigue tests on non-irradiated samples of DIN 1.4948 stainless steel are discussed. Initial results of aerosol experiments in condensing atmospheres in a 20 m^3 vessel are given. Progress regarding the experiments on integral sodium boiling in a twelve-rod bundle and local boiling in a partially blocked 28-rod bundle is reported; a study of the changes in heat transfer caused by damage to the surface roughness of a gas-cooled fuel rod is described. (30 references) (auth)

16276 EXPERIENCE WITH THE DEVELOPMENT OF THE BN-350 AND BOR-60 POWER PLANT PUMPS. Mitenkov, F. M.; Chernomordik, E. N.; Koskin, Yu. N.; Saronov, V. M.; Novinskii, E. G.; Popov, V. M. (Research Inst. for Nuclear Reactors, Dimitrovgrad, USSR). Kernenergie; 18: No. 4, 105-113(Apr 1975). (In German).

The results of design, improvement, mounting, and starting works on the BOR-60 and BN-350 reactor pumps are presented. The construction of the primary and secondary coolant loop circulation pumps of these power plants is briefly discussed. The main parameters and the materials used are given. Moreover, the following problems and data are considered and discussed: problems of experimental studies of the flow-through section, bearings, and shaft seal against gas; the main data on improving the model pumps on special test rigs; drawbacks of the construction; penetration of oil from the pumps into the coolant loop; the results of experimental tests; problems in connection with mounting, starting, and improvement of the BOR-60 pumps; works provided for further improvement of the pumps; and application of the experience gathered during design of the pumps. (auth)

16277 NUCLEAR FUEL PREHEATING SYSTEM. Andrea, C. (to Combustion Engineering, Inc.). US Patent 3,884,624. 20 May 1975. Filed date 15 Aug 1973. 4p.

A nuclear reactor new fuel handling system which conveys new fuel from a fuel preparation room into the reactor containment boundary is described. The handling system is provided with a fuel preheating station which is adapted to heat the new fuel to reactor refueling temperatures in such a way that the fuel is heated from the top down so that fuel element cladding failure due to thermal expansion is avoided. (Official Gazette)

16278 BREEDER ALTERNATIVES. Koch, L. J. (Illinois Power Co., Decatur). Combustion.; 46: No. 12, 32-37(Jun 1975).

The various types of breeder reactor systems are examined and compared. These systems include the LMFBR, the GCFR, the LWBR, and the MSBR. (JWR)

16279 EXTRACTION METHOD FOR THE FISSION PRODUCTS OF A NUCLEAR REACTOR COOLANT. Cooper, M. H. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,209,176/A/. 27 Sep 1973. 10p. (In French).

The invention concerns the decontamination of a reactor coolant. The coolant is carried at high temperature through a first trap where a reactant is added and then carried at low temperature across a second trap where the reactant and the fission products precipitate. When the reactants of the first trap are spent, the direction of flow is reversed. (tr-FR)

16280 A FRICTIONLESS RAPID SELF-OPENING AND CLOSING DIAPHRAGM VALVE. Pintapary, M. French Patent 2,212,901/D/. 28 Dec 1972. 7p. (In French).

A frictionless diaphragm-valve capable of rapidly opening and closing for all pressurized liquids at temperatures up to 600°C is described. The valve comprises a two-part body, within which a movable member of ogival shape carried by a shaft is rotated by a jack and disengaged from said body by means of rods. The valve can be used in safety installations, in particular in the generators of nuclear power stations along the liquid sodium circuits. (FR)

16281 RESULTS OF THE EXPERIENCE GAINED ON VESSEL MATERIALS FOR PHENIX. Future Prospects. Berge, P.; Donati, J. R.; Valibus, L. (Electricite de France, 77 - Ecuelles. Dept. Etudes des Materiaux); Petrequin, P.; Sebilleau, F.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). pp 44-48 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The design of the upper structure of the main Phenix vessel in connection with shapes, thickness, and temperatures led to a study of the low ferrite 316 L steel that was chosen. Results are given of the studies made on the delayed cracking of heat-affected zones, the mechanical strength, ductility and dimensional stability at high temperatures and the structural stability. (FR)

16282 THE NUCLEAR ENERGY PROBLEMS. Rech. Tech.; No. 8, 12-19(Jun 1974). (In French).

The U isotope separation processes are reviewed: gaseous diffusion, ultracentrifugation, separation nozzles, thermal diffusion, electromagnetic separation. Then the development of the fast neutron reactors and HTGR reactors is examined. (FR)

16283 A METHOD AND DEVICE FOR THE PASSIVE PROTECTION OF A NUCLEAR REACTOR. Cachera, P. C. (to Electricite de France, 75 - Paris). French Patent 2,210,801/A/. 20 Dec 1972. 9p. (In French).

Description is given of a method and a device for the passive protection of a nuclear reactor by fusion of part of the fuel under the action of a neutron flux excursion. The device is characterized in that each "safety" member is constituted by a stack of fuel pellets enclosed in a sheath, each pellet having a central opening the diameter of which is large enough for allowing the molten fuel portion to flow by the gravity down to the lower portion of the fuel-element. That method can be applied to fast neutron reactors. (FR)

16284 THE MAIN PROBLEMS RAISED BY THE IN-PILE BEHAVIOR OF MIXED OXIDES. Mikailoff, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). pp 108-110 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

An important program of mixed-oxide irradiations for fast reactors has been pursued at the CEA for about 15 years. About 500 fuel elements have been irradiated either in instrumented capsules in HTR-type reactors, or in Rapsodie subassemblies. The experiments were conducted at a burnup up to 17% and a maximum cladding temperature of 750 deg C. A review of the results is presented. They concern the physico-chemical evolution and volume variations of the oxides and carbides and their compatibility with the cladding. These results deal with sintered mixed fuels containing 20% plutonium oxide or carbide and clad with stainless steel 316. (FR)

16285 IRRADIATION OF VENTED FUEL ELEMENTS FOR FAST REACTORS. Cecchi, P. F. ('Comitato Nazionale per l'Energia Nuclear, Bologna (Italy)); Perrin, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Piles); Chenebault, P.; Kurka, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). pp 111-113 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The irradiation program of vented fuel pins is presented. It started in 1971 and is still in progress. The global aim of the program is to study the behavior of fuel pins operating at relevant burnup and to test the efficiency of the diving-bell venting device to prevent the transport of fission products into the coolant. (FR)

16286 CARBIDE FUEL ELEMENT FOR FAST REACTORS. Research and Development Program. Lallement, R.; Mikailoff, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium); Ravier, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). pp 113-114 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

He-bonded and Na-bonded carbide fuel elements were studied. The principal irradiation results are given: swelling, gas retention and gas release, fuel-cladding interactions. The reference fuel element chosen is a vented and sodium-bonded element. The objective that has been fixed in the irradiation program is to demonstrate the satisfactory behavior of carbide fuel by 1980. The program includes studies of both normal and abnormal behavior conditions. (FR)

16287 DESIGN IMPLICATIONS OF MATERIAL PROPERTIES ON LMFBR FUEL ELEMENTS. Capart, G.; Jonckheere, E.; Stevens, L. (Societe Belge pour l'Industrie Nucleaire, Brussels); Dietz, W.; Hochel, J.; Mayer, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). pp 116-119 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The final design of the fuel elements for SNR-300 has taken place during the past two years which made possible a larger account of the recently recognized implications of material properties under irradiation. The design measures taken range from the selection of the cladding and structural material to the optimization of the dimensions and mechanical flexibility of the various components. The design implications deriving from irradiation-induced void swelling and creep of the structural materials are presented. Some mention is also made of the implications from cladding material corrosion and thermal creep strength and of special friction and wear problems. (FR)

16288 CHOICE OF THE PHENIX FUEL ELEMENT CHARACTERISTICS. First Results of Their In-Pile Behavior. Leclere, J.; Marcon, J. P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). pp 119-120 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The Phenix fuel element characteristics had been fixed in 1970, thus taking in account the first results of the examination of the Rapsodie 24-MW(e) core and of high burnup experiments in fast flux. The general design of the Phenix fuel bundle, which had been reproduced as well as possible in some special experiments, has been validated by these results; especially the disposition of the lower axial blanket and the choice of a helicoidal wire as a spacer between pins. (FR)

16289 READILY REMOVABLE SECURING DEVICE FOR CONTROLLED ATMOSPHERE ENCLOSURES AND ROOFS. (to Societe Babcock-Atlantique, 75 – Paris (France)). French Patent 2,208,428/D/. 30 Nov 1972. 14p. (In French).

Pins are mounted in spaced relationship along the periphery of the enclosure coping-girder and act in the manner of supports for the dome-shaped roof, the belting girder of which is provided with holes for inserting pins. Blades, hinged about said pins in the manner of umbrella ribs, are capable of passing from an unfolded to a folded position in order to prevent the roof from rising undesirably or in order to permit raising it so as to have access to the enclosure for carrying out inspections or repairs. The device can be applied to enclosure roofs of the attic type for fast neutron nuclear installations. (FR)

16290 STEAM GENERATOR MATERIAL FOR SODIUM-COOLED FAST BREEDER REACTORS. Results and Future Prospects. Berge, P.; Donati, J. R.; Saint-Paul; Valibus, L. (Electricite de France, 77 – Ecuelles. Dept. Etudes des Materiaux); Champeix, L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides); Coriou, H.; Dixmier, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee); Petrequin, P.; Sebilleau, F.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Technologie). pp 41-44 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The main characteristics of Phenix and Super-Phenix steam generators are given. The steels studied for the steam generator tubing of these reactors and future reactors of this type are the following: low alloy $2\frac{1}{4}$Cr–1Mo steels (unstabilized, stabilized with Nb, stabilized with Nb and V); 9Cr–1Mo ferritic steel stabilized with Nb and V; 18Cr–10Ni austenitic stainless steels (Types 316, 316 L and 321); Incoloy 800. Characteristics of these various materials are evaluated with respect to the main criteria governing construction of the tube bundles and their performance in service. Mechanical characteristics at high temperature are discussed along with fabrication and welding, behavior with respect to mass transfer in sodium, carburization and decarburization and corrosion resistance. (FR)

16291 IN-PILE SAFETY TESTS ON FAST REACTOR FUELS. Bailly, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Surete Nucleaire); Kessler, G. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)); Teague, N. J. (UKAEA Safety and Reliability Directorate, Risley). pp 193-195 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Reactivity accidents occurring in a reactor in normal operation or following an untripped cooling failure form the objective for a second program of studies CABRI carried on in the framework of collaboration between the CEA and the Gesellschaft fuer Kernforschung (GFK). The results obtained and the objectives of the current program are presented. (FR)

16292 SUPER-PHENIX FUEL ELEMENT DESIGN. Leclere, J.; Ollier, H.; Rousseau, J.; Boyer, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). pp 120-123 of La maturite de l'energie nucleaire. Lehoullier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

In spite of the technological continuity, the passage from Phenix to Super-Phenix is a great enough step to justify an important volume of out-of-pile and in-pile tests, in addition to theoretical studies. Tests especially realized for Super-Phenix are described: out-of-pile tests, irradiation tests. (FR)

16293 COOLING SYSTEM FOR A NUCLEAR REACTOR CORE. Redding, A. H. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,209,173/A/. 13 Sep 1973. 12p. (In French).

The cooling system consists of a method for decreasing the static pressure of the coolant when it leaves the device to be cooled and then to increase the static pressure when it again enters the device. The system is applicable to reactor cores. (tr-FR)

16294 ACCELERATING THE COMMERCIAL LMFBR. Balent, R.; Lorenzini, P. G. (Rockwell International, Canoga Park, CA). Proc. Am. Power Conf.; 36: 170-176(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Design characteristics of LMFBR reactors are discussed. Development programs for commercial LMFBR reactors are reviewed. (DCC)

16295 PLANNING FOR THE SECOND LMFBR DEMONSTRATION PLANT: A 1000-MW COMMERCIAL PROTOTYPE. Noyes, R. C. (Combustion Engineering, Inc., Windsor, CT); Vitti, J. A.; Penfield, S. R. Proc. Am. Power Conf.; 36: 177-184(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

16296 COST TARGETS FOR COMMERCIAL LMFBRs. Palmer, R. S.; Horst, K. M. (General Electric Co., Sunnyvale, CA). Proc. Am. Power Conf.; 36: 186-192(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

16297 PROGRESS TOWARD THE COMMERCIAL LMFBR. Murray, P.; Dyos, M. W. (Westinghouse Electric Corp., Madison, PA). Proc. Am. Power Conf.; 36: 193-199(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

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Refer also to abstracts 15876, 16262, and 16639.

16298 (ANL-75-14) CENTRAL WORTH DISCREPANCY IN THREE FAST REACTOR BENCHMARK CRITICAL ASSEMBLIES. Bohn, E. M. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 46p. Dep. NTIS $4.00.

The central reactivity worth discrepancy in three fast reactor Benchmark assemblies, ZPR-6-6A, ZPR-6-7 and ZPR-3-48, has been systematically investigated. Several factors that could possibly contribute to the discrepancy were considered, including: (1) approximations inherent in the application of first-order perturbation theory, (2) calculations of spatial flux shapes and fission rate integrals, (3) delayed neutron parameters, and (4) broad-group cross sections. Analysis of sample size effects and local flux distortion effects indicates that the application of first order perturbation theory to the small sample measurements in the three assemblies does not introduce significant errors. Extensive measurements of fission rate distributions, when compared with the standard methods of analysis, indicate that flux shapes and fission integrals are computed well and do not contribute significantly to the central worth discrepancy in these assemblies. The impact of uncertainties in delayed neutron parameters on the central worth discrepancy was evaluated with sets of sensitivity coefficients computed for each assembly. Use of the evaluated absolute delayed neutron parameters of ENDF/B-Version IV was found to reduce the discrepancy 3-5 percent in these assemblies. Uncertainties in broad group cross sections and their effect on the discrepancy were evaluated with cross section sensitivity coefficients computed for each assembly. It was found that modifications to broad group cross sections, suggested by results of integral measurements in these assemblies, significantly reduced the central worth discrepancy in the three Benchmark assemblies. (auth)

16299 (EURFNR-1201) UO_2–PuO_2 FUEL PIN BUNDLE IRRADIATION DFR 350 EVALUATION OF THE POST-IRRADIATION EXAMINATION RESULTS. Ehrlich, K.; Goetzmann, O.; Kleykamp, H.; Schaefer, L.; Schulz, B.; Zimmermann, H.; Dienst, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jun 1974. Translation of KFK-1960. 107p. Dep. NTIS $5.45.

Work performed under United States–Euratom Fast Reactor Exchange Program.

In the irradiation test DFR-350 UO_2-PuO_2 fuel pins (290 mm fuel length) were irradiated in a pin bundle cooled by flowing NaK. Irradiation was performed in the fast neutron flux of the test reactor DFR (Dounreay) at mean rod powers between about 320 W/cm (bottom fuel end) and 440 W/cm (neutron flux maximum) to a maximum burnup of 5,7 at.% (U + Pu). The maximum fast neutron fluence amounted to $3.8 \times 10^{22} n/cm^2$ (E > 0,1 MeV). The mean cladding i.d. temperature was between about 300°C and 650°C (at the cooler end and at the hot end of the fuel pin). The post-irradiation examination of 15 fuel pins is presented. (auth)

16300 (EURFNR-1244) ANALYSIS OF SEFOR EXPERIMENTS. Bogensberger, H. G.; Caldarola, L.; Mitzel, F.; Oosterkamp, W. J.; Wintzer, D. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jan 1975. 111p. (KFK-2095; EUR-5200e). Dep. NTIS (US Sales Only) $5.45.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Methods and results of the analysis of several SEFOR zero power and power experiments are described. The Doppler temperature coefficients as evaluated from several SEFOR Doppler experiments are in good agreement with GE results, although evaluation methods differ in several details. The evaluated Doppler temperature coefficients are slightly overestimated by nuclear calculations. However, the overestimation is within the estimated uncertaintie[illegible] evaluations from experiments. (auth)

16301 (GA-A-13333) FEASIBILITY STUDY OF THE DRAGON REACTOR FOR HTGR FUEL TESTING. Wallroth, C. F. (General Atomic Co., San Diego, Calif. (USA)). 3 Mar 1975. Contract AT(04-3) 167. 52p. Dep. NTIS $5.45.

The Organization of European Community Development (OECD) Dragon high-temperature reactor project has performed HTGR fuel and fuel element testing for about 10 years. To date, a total of about 250 fuel elements have been irradiated and the test program continues. The feasibility of using this test facility for HTGR fuel testing, giving special consideration to U. S. needs, is evaluated. A detailed description for design, preparation, and data acquisition of a test experiment is given together with all possible options on supporting work, which could be carried out by the experienced Dragon project staff. (11 references) (auth)

16302 (GEAP-3289) BWL DECONTAMINATION. Siegel, S. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Atomic Lab.). 11 Nov 1959. 15p. General Electric Co., San Jose, CA.

Activities associated with the decontamination of the boiling water loop (BWL) at the GETR facility are described. (JWR)

16303 (HEDL-TME-75-29) IN-SERVICE EXAMINATION OF IHX TUBING WITH EDDY CURRENT NDT EQUIPMENT. Brown, R. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1972. Contract AT(45-1)-2170. 36p. Dep. NTIS $4.00.

Single and multiple frequency eddy current (ET) nondestructive testing (NDT) techniques and equipment were investigated for in-service inspection of sodium-contaminated intermediate heat exchanger (IHX) tubing. A four frequency technique, demonstrated in the laboratory, was relatively insensitive to signals caused by probe motion, tube support plates, and residual sodium on the outer surface of the tubes. No method was found to avoid the signals from residual sodium on the inside surfaces of the tube. (auth)

16304 (LA-5946-MS) TUNGSTEN-CARBIDE CRITICAL ASSEMBLY. Hansen, G. E.; Paxton, H. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 3p. Dep. NTIS $4.00.

The tungsten-carbide critical assembly mainly consists of three close-fitting spherical shells: a highly enriched uranium shell on the inside, a tungsten-carbide shell surrounding it, and a steel shell on the outside. Ideal critical specifications indicate a rather low computed value of k/sub eff/. Observed and calculated fission-rate distributions for ^{235}U, ^{238}U, and ^{237}Np are compared, and calculated leakage neutrons per fission in various energy groups are given. (auth)

16305 (LA-5971-MS) RESEARCH PROGRAM ON PLASMA CORE ASSEMBLY. Bernard, W.; Helmick, H. H.; Jarvis, G. A.; Plassmann, E. A.; White, R. H. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-ENG-36. 4p. Dep. NTIS $4.00.

An operating critical assembly having a 1.024-m-diam by 1.055-m-high cavity reflected by 0.48 m of beryllium has been constructed of residual beryllium reflector segments, control drums, drive motors, and control console from the solid core nuclear rocket development program. The critical mass for uranium distributed throughout the cavity is 16.9 kg U(93.2), which is high because of neutron undermoderation in the reflector due to porosity and poison contaminants in the beryllium and graphite reflector components. A flux trapping beryllium annulus, 0.546-m-i.d. by 0.89-m-o.d., centered in the cavity, reduced the critical mass to 6.7 kg U(93.2). This arrangement will permit operation with a UF_6 zone inside the flux trap driven by an outer uranium-graphite fuel zone. The fission density inside the flux trap is appreciably higher than in the outer fuel zone. (auth)

16306 (ORNL-TM-4895) BULK SHIELDING FACILITY QUARTERLY REPORT, OCTOBER, NOVEMBER, AND DECEMBER OF 1974. Hurt, S. S.; Lance, E. D.; Thomas, J. R. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 27p. Dep. NTIS $4.50.

The BSR operated at an average power level of 1,919 kw for 39.33% of the time during October, November, and December. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The BSR was operated at low and variable power during this quarter for 44.950 hours as part of the training programs for nuclear engineering students from the University of Kentucky and for Tennessee Valley Authority (TVA) personnel from Sequoyah. The PCA was also used in the above-mentioned training programs and was operated on seven occasions when TVA personnel or University of Kentucky students actively participated in training laboratories. (auth)

16307 (NP-20427) DANISH ATOMIC ENERGY COMMISSION ANNUAL REPORT, 1 APRIL 1973–31 MARCH 1974. (Atomenergikommissionen, Copenhagen (Denmark)). 7 Mar 1975. 159p. (In Danish). Dep. NTIS (US Sales Only) $11.00.

Activities of the Danish Atomic Energy Commission and the Riso Research Establishment for the period April 1, 1973 to March 31, 1974 are summarized. The operations of the various facilities at the Research Establishment are revised. Operating staff levels and financial data are tabulated, and a list of staff publications is given. (DE)

16308 METHOD OF MONTE CARLO FITTING. Klotzkin, G.; Swanson, R. W.; Harrison, L. J.; McPheeters, C. C. (Argonne National Lab., IL). Nucl. Sci. Eng.; 57: No. 3, 218-247(Jul 1975).

A method of Monte Carlo fitting is described that was used at the transient reactor test facility (TREAT) to calculate the ratio of energy deposition within an experimental fuel pin in a containment loop to the energy deposition at the peak power position in the reactor. The results of the Monte Carlo fitting are compared to experiment and to results of a direct Monte Carlo calculation, with good agreement. (auth)

16309 IN-SERVICE INSPECTION OF RAPSODIE SAFETY CONTAINMENT. Tomachevsky, E. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). pp 74 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Manually operated equipment was used which was simple enough to be reliable, rapidly manufactured and well designed to reach the safety containment through a complicated way to secure efficient protection for the inspectors. (FR)

16310 IRRADIATION BEHAVIOR OF THE MIXED-OXIDE DRIVER FUEL ELEMENTS OF RAPSODIE FORTISSIMO. Anselin, F.; Allain, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium); Mercier, C.; Clottes, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). pp 123-126 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The main results observed on subassemblies, fuel pins, oxide fuels, and fuel-cladding interactions after irradiation at the operational target burnup of 8.1 at % (6.5 10^{22}n/cm^2) are summarized. (FR)

16311 IRRADIATION BEHAVIOR OF THE MIXED-OXIDE DRIVER FUEL ELEMENTS OF RAPSODIE 24 MW. Anselin, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium); Mercier, C.; Clottes, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). pp 126-129 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The main results concerning the driver fuel elements from start-of-life to the ultimate term of their irradiation (8.2 at %; 7.5 10^{22}n/cm^2) are summarized. (FR)

16312 HIGH BURNUP MIXED-OXIDE FUEL IRRADIATION EXPERIMENTS IN RAPSODIE. Anselin, F.; Carteret, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium); Bataller, S.; Chalony, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). pp 129-132 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The main results concerning both subassemblies and fuel pins are summarized (dimensional changes in subassemblies and pins, behavior of the oxide fuel, cladding corrosion). (FR)

16313 UTILIZATION OF THE OSIRIS RESEARCH REACTOR FOR STUDIES OF FUEL BEHAVIOR IN ACCIDENTAL CONDITIONS. Breant, P.; Zecevic, G.; Marfaing, R.; Graf, J. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Services des Piles). pp 173-174 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Tests for high-temperature, water and fast-neutron reactors are described. (FR)

16314 PROBLEMS OF RADIOLOGICAL SAFETY NEAR THE RESEARCH REACTOR OF THE TEHRAN UNIVERSITY. Sarram, M. (Teheran Univ. (Iran)). Radioprotection; 9: No. 3, 211-220 (1974). (In French).

The Tehran University Research Reactor (T.U.R.R.) is a 5MW reactor which went critical in November 1967. The reactor pool experienced a high leakage rate after the first operation at full power. A lining of stainless steel 304-L was installed inside the pool to stop the leakage. Lining of the pool called for the drainage of water and transfer of radioactive fuel elements into a new safe geometry. Safety features for the transfer of fuel elements from the core are presented. Although the pool was made completely watertight, the lining created a few radiation hazard problems. The more important problems being the gamma streaming problem from the gap between the wall and the lining, also the bubbling effect from the lead piece in front of the thermal column was a serious radiation safety problem. Details of these and other problems are discussed. (FR)

16315 A METHOD FOR IRRADIATING THE FUEL-ELEMENTS OF A POOL-REACTOR, AND A DEVICE FOR CARRYING OUT SAID METHOD. Marin, Francois. (to CEA, 75 – Paris (France)). French Patent 2,210,804/A/. 15 Dec 1972. 9p. (In French).

The invention relates to a method for irradiating the fuel-elements of a pool-reactor and studying the behavior thereof. According to the invention, a tightly-sealed container housing the element to be irradiated is introduced into the water of a reactor, the container being mounted within an outwardly-heat insulated gas flow loop, the temperature of the gas around the container being made substantially equal/to, or slightly higher than, that of the water flowing through that container. (FR)

16316 DETECTION OF LEAKAGE RADIATION DURING OPERATION OF THOR AND THAR BY THERMOLUMINESCENT DOSIMETERS. Lin, H. H.; Hsu, P. C. (National Tsing-Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 1, 54-59(Mar 1975). (In Chinese).

Thermoluminescent dosimeters were used to monitor the radiation leaking out from the cores of Tsing Hua Open Pool Reactor and Tsing Hua Argonaut Reactor during their operation. The cause of leakage was investigated and discussed. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstract 16230.

Propulsion and Package Reactors

Refer also to abstracts 14801, 14802, 14811, 14958, 14963, 16556, 16573, 16574, and 16640–16645.

16317 (AGC-2420) NUCLEAR ROCKET PROPULSION SYSTEMS FOR ADVANCED APPLICATIONS. A Preliminary Survey. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1962. 99p. Dep. NTIS $8.00.

Declassified 10 Sep 1973.

A preliminary summary of nuclear rocket propulsion system information is provided for use by those engaged in the analysis and conceptual design of advanced space systems. The report is divided into three major sections. The first is devoted to nuclear rocket engine characteristics, wherein the present, in-development NERVA engine is described and its performance discussed. This is followed by parametric engine performance, weight and dimensional information. Reliability, engine life, start-up and shut-down, and radiation effects considerations are included. The second major section is a discussion of engine support systems, while the third presents development plans and costs. (auth)

16318 (AGC-2697) REON COMMENTS ON THE PROPOSED LMSC OFFSET-GIMBAL ENGINE SUSPENSION SYSTEM. (Aerojet-General Corp., Azusa, Calif. (USA)). Oct 1963. 38p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

An evaluation of an offset gimbal configuration has been made. The evaluation consists of drawing review, analysis, and comments on the mechanical design of the configuration. Where applicable, the configuration has been compared to the NERVA engine design. It appears that it would be possible to design a NERVA engine utilizing the offset-gimbal suspension system, which would be capable of meeting the NERVA program requirements. It is concluded, however, that there are no significant advantages to be gained by such a design. It is further believed that there are disadvantages with respect to engine remote handling problems and gimbal actuator power requirements, as described. (auth)

16319 (FZK-302) AREA REDUCTION MEASUREMENTS OF FRACTURED TENSILE SPECIMENS. (General Dynamics Corp., Fort Worth, Tex. (USA). Convair Aerospace Div.). 11 May 1966. 8p. Dep. NTIS $4.00.

For Aerojet-General Corp., Sacramento, CA.

More accurate values of the reduced cross-sectional areas were taken from magnified photographs of selected AGC fractured tensile test specimens located at NARF. The specimens were from GTR-16 and previous tests. Cross-sectional areas of the fractured edges of the specimens were measured with a planimeter, reduced by the magnification factor, and recorded. A total of 140 specimens were photographed and measured, using an average of four measurements to determine the fracture area. The specimens were fabricated from the following materials: A-286, Al-356-T6, Al-6061-T6, Al-7075-T6, Hastelloy C, Inconel 713-C, Inconel X-750, SS-347-C, and Ti-A-110-AT. All data obtained are shown. (auth)

16320 (GKSS-75/E/1) SCIENTIFIC-TECHNICAL REPORTS OF THE GKSS 1974. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1975. 44p. (In German). INIS.

The survey contains data on titles and authors of all GKSS reports that appeared in 1974. Abstracts and bibliographic data of external reports are given. (GE)

16321 (LA-3867) THERMIONIC SPACE POWER SUPPLIES UTILIZING SNAP-8 SYSTEM COMPONENTS. Frank, T. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1968. Contract W-7405-ENG-36. 22p. Dep. NTIS $4.25.

Declassified 31 Aug 1973.

An investigation has been carried out to determine the feasibility of replacing part of a SNAP 8 reactor core with thermionic diodes to obtain a few kilowatts of electrical power. Two designs of thermionic space power supplies, based on the use of SNAP 8 reactor fuel elements and other SNAP reactor and system components, have been evaluated. A departure from the use of SNAP system components is the waste heat radiator design which, for the thermionic power supplies, is a heat-pipe radiator. Each design contains 12 thermionic fuel rods. The thermionic fuel rods in one are fueled with $^{233}UO_2$, and the other contains thermionic fuel rods fueled with $^{235}UO_2$. The weight and geometry of the reactor containing $^{233}UO_2$ fueled thermionic fuel rods are essentially the same as the SNAP reference design reactor. The nominal electric output of this design is 23.5 kW. It was necessary to increase the size of the reactor containing $^{235}UO_2$ fueled thermionic fuel rods to obtain the desired reactivity. The nominal electric output of this design is 32.5 kW. 7 references. (auth)

16322 (LAMS-2582) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING JUNE 20, 1961. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1961. Contract W-7405-ENG-36. 63p. Dep. NTIS $6.25.

Declassified 29 Aug 1973.

Developments were mostly related to the early KIWI reactors: pressure vessel and nozzle testing, fuel element development (to prevention of hydrolysis, niobium tube liners which were then carbided, etc.). Test cell facilities for testing the reactors are progressing. Computer calculations and simulations of reactor behavior have given favorable results. Various design heat transfer, fluid flow and materials study results are reported. (LTN)

16323 (NAA-SR-9469(Vol. 5)(Pt. D) SNAP 8 DEVELOPMENT PLAN: FISCAL YEARS 1965–1966. Part I. (Atomics International Div., Canoga Park, Calif. (USA)). 1 May 1964. 183p. Dep. NTIS $12.25.

Declassified 28 Nov 1973.

Information is presented concerning the development, fabrication, and performance testing of fuel elements; the development of control elements drives; instrumentation, safety components; shielding; and nuclear system test program. (DCC)

16324 (NTO-M-15563) SUPPORT OPERATIONAL REQUIREMENTS DOCUMENT FOR NES DESIGN DEMONSTRATION TEST, PHASE II. NTO-I-0223, Revision A. Final Issue. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Jun 1967. 62p. Dep. NTIS $6.25.

Phase I tests of the NES Duct demonstrated the performance capabilities and structural integrity by flowing cold gaseous nitrogen at mass flow rates and pressures required for equivalent engine thrust conditions. The Phase II test program will be conducted at approximately the NERVA engine intermediate power level condition which is above the duct "pull-in" point utilizing first gaseous nitrogen and then gaseous hydrogen as the primary fluid. The effects of excessive engine test compartment (ETC) seal leakage and excessive turbine exhaust flow will be investigated. In addition, the thermal radiation on the Test Stand from the exhaust plume will be investigated. (auth)

16325 (NTO-M-18003) ETS-1 SAFETY AND WARNING PROCEDURE. Review Issue of NTO-A-0030, Section 019. Erickson, N. E. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 25 Jul 1967. 30p. Dep. NTIS $4.50.

The safety and warning systems at ETS-1 are described briefly, and instructions, rules and philosophy for their use are provided. Included are general rules pertaining to the handling of propellants and pressurized gases and liquids which should aid in the general facility safety practices and procedures. This procedure pertains to all safety and warning systems and equipment at ETS-1 and is intended to support the ETS-1 Emergency Procedure. (auth)

16326 (NTO-M-20880) NTO SEMIMONTHLY PROGRESS REPORT, JANUARY 16–JANUARY 31, 1968. Wayne, W. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 7 Feb 1968. 28p. Dep. NTIS $4.50.

Several hundred details related to NTO test facility operations, tests or modifications are discussed briefly. (LTN)

16327 (RN-DR-0020(Rev.)) NERVA X-ENGINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1964. 56p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

Preliminary design specifications are given for the XE-1, Hot Bleed, Externally Shielded, Nuclear Rocket Engine. This is to be a ground-test, experimental version of the NERVA. (LTN)

16328 (RN-S-0028) REON REACTOR TASK GROUP. CY 1963 Activities. (Aerojet-General Corp., Azusa, Calif. (USA)). Dec 1963. 49p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

The REON Reactor Task Group, initially organized in early 1962, has contributed several items for consideration in the design of reactors for NERVA. These items are summarized with respect to the Kiwi B-2A, B-4A, B-4D, NRX-A and NRX-B reactors. Some preliminary design considerations for NRX-B are discussed and illustrated. Continuing effort of comparable magnitude is planned in support of LASL and WANL developments. (auth)

16329 (RN-S-0036) NON-LINEAR OSCILLATIONS OF REACTOR CORES. (Aerojet-General Corp., Azusa, Calif. (USA)). Jan 1964. 14p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

Analyses are presented for some possible modes of non-linear vibration in which parts of the ROVER reactor core might separate. These analyses include investigations of (1) non-linear effects of separation of the core from its support blocks, (2)

reactivity and power fluctuations which might occur during one possible non-linear mode of core motion, and (3) possible coupling of nuclear and mechanical modes of core motion. (auth)

16330 (RN-S-0050) RADIATION ANALYSIS OF MECHANICAL IRRADIATION TESTS 901–904. (Aerojet-General Corp., Azusa, Calif. (USA)). Jan 1964. 59p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

The results of radiation analyses performed in support of Mechanical Irradiation Tests 901, 902, 903 and 904 are reported. Comparisons are made between the calculated test environment and the comparable NERVA flight environment. Comparisons are also made with experimental results in those cases where experimental data were available. Fast neutron flux and gamma ray dose-rates and integrated doses are reported, as well as the neutron-to-gamma number flux ratio for each component as it appears in NERVA and the GD/FW ASTR test. Gamma heating rates are also presented in the same context. (auth)

16331 (RN-S-0077) DOSE PROBABILITY CONSIDERATIONS ASSOCIATED WITH THE RE-ENTRY OF A FRAGMENTED NUCLEAR ROCKET ENGINE. (Aerojet-General Corp., Azusa, Calif. (USA)). May 1964. 42p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

A dose-probability model is developed for the evaluation of external "whole-body" gamma exposures to the earth population resulting from fuel fragments produced by suborbital destruct of a nuclear rocket engine. The model is applied to a "worst-case" failure of a nuclear engine prior to achieving 100-nautical-mile orbit. Experimental and analytical data in the literature are used where applicable. (auth)

16332 (RN-S-0173(Vol. 3)) NERVA TECHNICAL REVIEW MEETING, AEROJET-GENERAL CORPORATION, SACRAMENTO, CALIFORNIA, NOVEMBER 17–19, 1964. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1964. 250p. Dep. NTIS $15.50.

Declassified 10 Sep 1973.

Revised material relating to reactor control systems, test facilities and support and remote handling equipment which was presented at the NERVA Technical Review Meeting held at Sacramento, California, November 17–19, 1964 is documented. (auth)

16333 (RN-S-0217) FINAL REPORT FOR PHASE I-B OF THE COUNTERMEASURES RADIATION EFFECTS PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). Apr 1965. 59p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

Results of Phase I indicated that high-temperature stability and the presence of an aromatic structure imparted radiation stability to explosive compounds, and that composite propellants were radiation-stable. Therefore, this phase investigated the best materials from Phase I (DATB explosive and ANP 3095 propellant), other aromatic high-temperature-stable explosives (TATB, DIPAM, HNS, and NONA), high-temperature-stable propellant AK-14, black powder, and two special high-temperature explosives obtained by NASA. High-temperature stability is necessary because of the high gamma heating rate, and is particularly important for an uncooled destruct system on the NERVA II engine. (auth)

16334 (RN-S-0249) DATA ANALYSIS REPORT OF NRX-A3 TESTS. Altseimer, J. H.; Fenech, E. J.; Kasahara, M.; Sebek, E. J.; Wilgus, C. A. (Aerojet-General Corp., Azusa, Calif. (USA)). May 1966. 324p. Dep. NTIS $19.25.

Declassified 10 Sep 1973.

Analyses of NRX-A3 data were conducted to determine the system's performance characteristics. In addition, the system's performance was evaluated against the characteristics calculated with an engine transient computer program. A normal population data test program was used to obtain the test data best estimates for these analyses. Several aspects of the system's performance were examined, including the following: Maximum power operating conditions, power level analysis technique and results, statistical analysis and reliability of test data, emergency flow shutdown, temperature distributions in various plenums, comparison of actual to computed performance parameters, propellant characteristics at the pump inlet and outlet, and fluid temperatures in outer reflector outlet, shield dome end, and core inlet plenums at power holds. (auth)

16335 (RN-S-0469(Rev.1)) E-1 COMMON ANALOG MODEL. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1969. 62p. Dep. NTIS $6.25.

Declassified 7 Sep 1973.

Equations and data used in the NERVA simulation model are provided. (LTN)

16336 (RN-TM-0294) RADIATION EXPOSURE TO CREW DURING OPERATION OF A MANNED NUCLEAR SPACE VEHICLE. Garrington, G.; Kimura, B. T.; Warman, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 3 Jan 1966. 59p. Dep. NTIS $6.00.

Results are presented from a preliminary study of the radiation exposure of crew members during operation of a manned nuclear space vehicle. The various contributing components of the total radiation dose are evaluated and the effects of stage operation, engine shielding, and crew shielding are explored. A conceptual spacecraft crew shielding configuration composed of water is proposed which can perform as a space radiation protection device during most of a prolonged mission and serve as a reactor shield during the brief period when the nuclear propulsion system is operated. The water in this shield could also serve as a combination life support system component and sanitation retention system in a compartment tank design. It appears that the integral design of the engine shield and such a crew radiation protection system can possibly result in the design of nuclear space vehicles which have no biological shielding weight increases over that required for space shielding. (auth)

16337 (RN-TM-0583) NERVA-FLIGHT-ENGINE COMMON RADIATION-ANALYSIS MODEL. Wilcox, A. D.; Lindsey, B. A.; Capo, M. A. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). May 1968. 80p. Dep. NTIS $7.00.

Declassified 10 Sep 1973.

Basic geometrical, material, and radiation source data are presented to serve as a common radiation-analysis model for the NERVA flight-engine configuration with a candidate brim shield and a candidate disk shield. These data provide the standard representation of the NERVA flight engine for overall radiation analyses of the system. More detailed representation of the reactor subassembly may be required in order for Westinghouse to discharge its responsibilities in that area. Similarly, more detailed representations of the pressure vessel, brim shield, disk shield, nozzle, and other engine components may be required in order for Aerojet to discharge its responsibilities in these areas. Such details are considered supplemental and are not a part of this common model. Some more detailed representations may be included in the model, where appropriate, at a later date. (auth)

16338 (RP-DR-0005) PHOEBUS-2 SIX MONTHS MATERIALS DEVELOPMENT REPORT FOR 15 AUGUST 1966–15 FEBRUARY 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1967. 72p. Dep. NTIS $6.75.

Declassified 10 Sep 1973.

The materials design-properties testing program was completed. The grooved-tensile tests revealed that the braze joint carries its share of the hoop-tension loads. Low-cycle fatigue tests indicated a satisfactory thermal-strain cycle life for Hastelloy X in the brazed condition. The engineering and design effects of nickel-plating on the braze cycle have been evaluated. The shear strength of the joint was shown to be unaffected by the thickness of the plating. The extra braze-cycle resulted in only a small decrease in the tensile elongation of the jacket material. Welding of the last nozzle-jacket assembly was accomplished successfully. Several procedures were evolved for successful repair of tubes and an improperly drilled coolant hole. Welding of the tori to the nozzle jacket is proceeding satisfactorily. All full-scale nozzle forgings have been procured and welded. The final and current test results from the individual annealed forgings are summarized by part number and heat number. (auth)

16339 (RP-QR-0008) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 MARCH 1967–31 MAY 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1967. 45p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

NERVA nozzle design, development fabrication and testing is reported. X-ray and ultrasonic methods of inspection are discussed. Nozzle testing failures (cracking of nine coolant channels, fail-safe shutdown with hardware damage, galling of thrust-chamber oxidizer valve) are reported. (LTN)

16340 (RP-QR-0009) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 JUNE 1967–31 AUGUST 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 24p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

Details of NERVA nozzle fabrication, repair and testing are reported. (LTN)

16341 (SD-71-466-2(Vol.2)(Pt.A)) NUCLEAR FLIGHT SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume II. Concept and Feasibility Analysis. Part A. System Evaluation and Capability. Garcia, D.; Jusak, A. R.; Antypas, W. G. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). Apr 1971. 720p. Dep. NTIS $39.00.

Important objectives of mission/performance analysis have been to test design alternatives on a payload capability basis and to provide a reference mission framework for subsystems analyses. A broader objective has been to investigate the interplay of mission requirements, RNS performance attributes (particularly those of NERVA), and space shuttle and space tug capabilities. Progress in defining mission requirements has come primarily through analysis of the lunar shuttle mission and its powered maneuvers. Wherever multi-impulse maneuvers could reduce theoretical velocity requirements, they have been applied to improve RNS performance. The requirement thus emerges for more engine starts per mission; however, for a minimum energy lunar mission with two translunar injection burns, there would be only five full power NERVA cycles. A dramatic increase in payload capability follows when a space tug is used to assist the return of the RNS at the end of a lunar mission. By refueling the RNS in elliptical orbit the tug permits an 80 percent increase in lunar payload. Analysis of earth operations orbit selection has afforded another example of multivariable interplay between space program elements. Involved are space shuttle capability, drag makeup for RNS and propellant depot, mission velocity requirements, and various constraints to be imposed on altitude and inclination. A payload limit favors higher earth orbit altitude—300 n mi and over—where drag and mission velocity factors are more favorable. The attractiveness of RNS design concepts has been measured in terms of cost/performance effectiveness, which is directly relatable to components weight including external radiation shield, structure, thermal and meteoroid protection, as well as mechanical, fluid and astrionic subsystems. Additional design drivers considered, that also affect performance and cost, include impact on the launch vehicle, facilities requirements, and complexity of flight operations. (auth)

16342 (TCR-9616-018) PHASE II. HEAT TRANSFER ANALYSES ON NERVA THRUST CHAMBER. Part I. Hester, J. N. (Aerojet-General Corp., Sacramento, Calif. (USA)). 29 Nov 1962. 93p. Dep. NTIS $7.75.

An analysis of the heat transfer characteristics of the NERVA thrust chamber during its operation in a nuclear environment was undertaken to determine the following: The behavior of the nozzle jacket and the nozzle-to-pressure vessel flange attached to either an aluminum or a titanium pressure vessel; the behavior of the core support rib and the core support flange; the behavior of the fuel torus flange; and the overall behavior of the thrust chamber assembly composed of the above components. The data on wall temperature distributions for steady state nuclear conditions indicate that the fuel torus flange is the only component that experiences heat transfer difficulties during exposure to nuclear radiation. The problem is attributed mainly to the unequal distribution of heat in relation to the location of the coolant. The lowest overall temperatures for the thrust chamber assembly attached to an aluminum pressure vessel were achieved with a 0.5 in. internal coolant manifold in the pressure vessel flange. In contrast, the lowest overall temperatures for the thrust chamber assembly attached to a titanium pressure vessel were obtained by relocating the external coolant torus around the pressure vessel and removing the internal coolant manifold. (auth)

16343 (TID/SNA-1925) TEST CELL C SINGLE TURBOPUMP MODIFICATION BASIS FOR DESIGN. (Braun (C. F.) and Co., Alhambra, Calif. (USA); EG and G, Inc., Las Vegas, Nev. (USA)). Sep 1971. 82p. Dep. NTIS $7.25.

Specifications are given for the design of modifications to Test Cell "C" for NERVA turbopump development and testing. These include LH_2 supply, power source, instrumentation, data acquisition systems, control equipment, etc. (LTN)

16344 (TID/SNA-2007) DIGITAL COMPUTER PROGRAMS FOR STEADY-STATE OR TRANSIENT TEMPERATURE ANALYSIS OF PLANE AND AXISYMMETRIC BODIES BY THE FINITE ELEMENT METHOD. Programs E12202, E12205, E12206, E12207. Engineering Operations Report. Kimura, L. A.; Thomas, E. A.; Yee, F. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 May 1972. 253p. Dep. NTIS $15.75.

The problem is to determine the temperature distribution of a complex two-dimensional body with various boundary conditions including radiation effects. The body can consist of several different materials; the material property parameters and boundary conditions can be both temperature and time dependent. The numerical procedures and the input instructions for the computer programs which provide the solutions are described. The basic numerical procedure is the finite element method—FEM. The advantages of the FEM as compared to other numerical approaches are numerous. The method is completely general with respect to geometry and material properties; complex bodies composed of many different materials are easily represented. Inherent in most numerical procedures is the solution of a set of linear equations for unknown mesh point temperatures. In the FEM the linear equations produce a symmetric positive-definite matrix in band form which is readily solved with a minimum of computer storage and time. In addition, the computer input can be made compatible with existing stress analysis programs; therefore, the computer input and the over-all time necessary for the complete thermal stress analysis is reduced. (auth)

16345 (TID/SNA-2271) REPORT ON ACTUATOR EVALUATION. Hart, W. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Oct 1963. 34p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

Electro-pneumatic actuators will be used for four different control functions in NERVA. The current status of an evaluation program for the two different actuator concepts is reviewed. (HDR)

16346 (TID/SNM-64) BUDGETARY STUDY FOR ENGINE/STAGE TEST STAND 2-3, NUCLEAR ROCKET DEVELOPMENT STATION, JACKASS FLATS, NEVADA. Volume I. Preliminary Report. (Kaiser Engineers, Oakland, Calif. (USA)). 11 Feb 1966. 219p. Dep. NTIS $14.00.

The purpose of the test complex is to provide the capability for testing large NERVA engine systems and complete nuclear propulsion modules. The Budgetary Study includes sufficient engineering to establish preliminary concepts, includes trade-off studies and at least partial optimization of the larger facility elements, and cost estimate with an expected accuracy of ± 15 percent. Effort has been concentrated on the review and modification of preliminary concepts and conclusions resulting from prior programmatic planning in the Criteria document and other studies received from SNPO. The facility concept reported represents a conservative approach, which is feasible but not necessarily resulting in the lowest possible facility cost. It includes site evaluation, development of the facility layout, safety and integrity considerations, describes the presently selected concepts and discusses alternate concepts considered in trade-offs which led to the present concepts. (auth)

16347 (TID/SNW-93) PLAN FOR MEETING THE NERVA PROGRAM FUEL ELEMENT REQUIREMENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Sep 1961. 23p. Dep. NTIS $4.25.

Declassified 7 Sep 1973.

16348 (TID/SNW-95) SECOND MONTHLY REPORT OF WNCO FUEL ENGINEERING. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Nov 1970. 77p. Dep. NTIS $7.00.

Declassified 10 Sep 1973.

Fuel element coating development was continued with the study of several coating parameters and evaluation of the product by corrosion testing and determination of cracks in the coatings and their effects. (LTN)

16349 (TID/SNW-96) ASTROFUEL FACILITY AT CHESWICK, PENNSYLVANIA. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Apr 1962. 33p. Dep. NTIS $4.75.

Declassified 7 Sep 1973.

The Westinghouse Astrofuel Facility has been specifically designed and equipped to produce nuclear reactor fuel elements of the graphite-enriched uranium type. The facility is equipped with a hot well, cooling tower, and monitor pit, which permit recirculation of process water and decontamination of waste water prior to discharging into the sanitary sewage system. The main stop is separated into several specific process areas with adequate storage space for both the radioactive and non-radioactive materials required to produce graphite fuel elements. Shop Area No. 1, which is temperature and humidity controlled, contains all powder operations such as dry blending and mixing, as well as the extruding and machining operations. Shop Area No. 2 houses the thermal treatment equipment used for curing, baking, graphitizing, coolant passages lining, and vapor phase depositing of niobium carbide. (auth)

16350 (TID/SNW-97) PW-2 DUPLEX COATING DEVELOPMENT: WEFF. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1968. 7p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The object of the proposed process parameters and equipment study is the development of a reproducible fuel element coating process consisting of a GEM(NbC) basecoat/HED(ZrC) hot end overcoat with rather precise thickness and thickness profile specifications. Furnace temperatures, time-temperature-gas composition and gas flow are the process parameters to be studied. Methods of inspection, evaluation and corrosion testing of the products are specified. (LTN)

16351 (TID/SNW-99) NRX-A6 CORROSION CHARACTERIZATION TEST SPECIFICATION, PHASE A6-C. Engineering Evaluation Corrosion Test Plan Definition. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1967. 14p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

A fuel element corrosion test is developed to provide engineering understanding of the corrosion performance characteristics of NRX-A6 fuel elements required for improvement of analytical models, understanding of reactor endurance factors, and a basis for augmentation of post test analyses and evaluations. The proposed corrosion test will evaluate the performance of NRX-A6 reactor grade fuel elements under conditions which permit the determination of prime operating and design parameter effects on corrosion by hydrogen: Matrix source, coating sources, power level, mass flow rate, time, number of cycles, fuel loading, and pressure level. Interaction effects among the above parameters, identification of other possibly significant parameters and study of variability in NRX-A6 fuel elements will be secondary objectives. (auth)

16352 (WANL-PR(CC)-48) COMPACT THERMOELECTRIC CONVERTER. Phase II-C. Final Report, 1 Jul 1968–30 June 1969. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Jul 1969. Contract AT(20-2)-2638. 192p. Dep. NTIS $12.75.

Declassified 30 Aug 1973.

Tubular thermoelectric module technology was advanced during Phase II-C of the Compact Converter Program to the extent that the baseline temperature for module testing was raised from 1000°F to 1100°F. A module incorporating material and design changes was tested in excess of 2000 hours at a peak temperature of 1150°F without any observable power degradation. Significant development work was performed to produce a system utilizing a heat pipe that transmitted thermal energy from an external heat source to a tubular module. During this phase of the program a complete conversion system consisting of a simulated heat source coupled to a tubular module with a Westinghouse heat pipe and a planar radiator was designed, fabricated, and placed on test. End closure designs on subsequent modules of this type improved the thermal cycling capabilities so that module performance remained unchanged after twenty-one cycles. Additional materials work has identified a secondary degradation diffusion mechanism at temperatures above 1100°F. Experiments have shown that techniques can be employed to prevent detrimental diffusion and, hence, allow successful operation at even higher temperatures. (auth)

16353 (WANL-PR(J)-027) NERVA NUCLEAR SUBSYSTEM. Progress Report, September 1, 1963 Through September 30, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Oct 1963. 102p. Dep. NTIS $8.25.

Declassified 10 Sep 1973.

Progress in reactor design, design and testing of reactor components, fuel element fabrication and coating development, corrosive effects of hydrogen, stress and thermal analyses, shielding design and shielding materials development, etc. is reported. (LTN)

16354 (WANL-PR(J)-029) WESTINGHOUSE ASTRONUCLEAR LABORATORY, NERVA NUCLEAR SUBSYSTEM. Progress Report, October 1, 1963–October 31, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Nov 1963. 107p. Dep. NTIS $8.50.

Declassified 10 Sep 1973.

The NRX-A1 reactor assembly and instrumentation was brought to within a few days of completion preparatory to shipping, while the NRX-A1 simulated shield was completed and readied for shipment. All shipping container, truck equipment, and railway equipment modifications for the NRX-A1 shipment were essentially completed, as were test site arrangements for off loading and receiving. The NRX-A1 Test Specification was reviewed and the final version is being revised for publication. The rough draft of the NRX-A2 Test Plan was reviewed and the NRX-A2 Test Specification is being prepared. Overall systems tests for the PAX nuclear mockup were completed with the exception of the final scram time measurements. Clustering for the plugged channel cold flow assembly was started with orificing of 90% of the elements completed. Half scale models of the NRX-A1 and the KIWI B4D were completed and delivered. (auth)

16355 (WANL-PR(J)-030) WESTINGHOUSE ASTRONUCLEAR LABORATORY, NERVA NUCLEAR SUBSYSTEM. Progress Report, November 1, 1963–November 30, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Dec 1963. 145p. Dep. NTIS $10.25.

Declassified 10 Sep 1973.

The NRX-A1 reactor and simulated shield was shipped by rail from Large, Pa. on November 14. The shipment arrived at Las Vegas on November 18, and the next day at Jackass Flats. Receiving inspection began immediately and by November 22 the reactor was positioned in the rotating fixture in the R-MAD building. Documentation pertinent to the NRX-A1 reactor included the NRX-A1 End Item Report and the three volume Pre-Operational Inspection Manual. The final NRX-A1 Test Specification was submitted for approval. A draft of the NRX Safety Analysis Report was completed. Drafts of handling and transport procedures for the PAX and Plugged Channel Flow test assemblies were completed. The NRX-A1 assembly checkout mockup was disassembled and its components modified to mate with PAX hardware. Assembly of the Plugged Channel Flow test core commenced. (auth)

16356 (WANL-PR(J)-031) WESTINGHOUSE ASTRONUCLEAR LABORATORY, NERVA NUCLEAR SUBSYSTEM. Progress Report, December 1, 1963–December 31, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jan 1964. 134p. Dep. NTIS $9.75.

Declassified 10 Sep 1973.

The inspection and checkout of the NRX-A1 reactor proceeded. Inspection of the nozzle end of the reactor and of the poison wires showed no defects after removal of the poison-wire-retainer plate, the wires themselves, and the retainer-plate adapter. Control drum torque readings were within the values specified. The reactor instrumentation check was completed, and the eddy current inspection was made. All mechanical measurements on the nozzle end of the core were made. Substantial progress was made in readying the site for the NRX-A1 test. The NRX-A1 test specification was approved. The assembly and testing of later NRX-A block I experimental reactors proceeded. All control drums for the pre-assembly experiment (PAX) reactor were fabricated. Investigations of materials and techniques continued. A review of the program for investigating radiation effects on components and materials was presented. To permit insertion and withdrawal of experiments during operation of the Plum Brook reactor, a trail-cable facility using the flow system of the presently installed W-2 loop was designed. A search for additional control materials (other than the B-10-A1 composition now in use) found europium oxide dispersed in an aluminum or steel matrix to be promising. The design of the Flexible Critical Experiment (FCX) was completed. The mechanical design of the NRX-B core cage reactor was described and evaluated in a published report. (auth)

16357 (WANL-PR(J)-032) NERVA NUCLEAR SUBSYSTEM. Progress Report, January 1, 1964–March 31, 1964. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Apr 1964. 273p. Dep. NTIS $16.75.

Declassified 10 Sep 1973.

The NRX-A1 cold flow tests were completed successfully at Test Cell "A". The core assembly reactor (Test G1) successfully underwent axial vibration tests. Inspection after the tests revealed no significant damage. The plugged channel reactor (Test G3) was assembled, shipped to WANHEF and installed in the test cell. Flow system modifications were completed, and the data acquisition system installed. The pre-assembly experiment (PAX) reactor was installed at WANEF, and the rod worth and reactivity determined. The safety analysis report was completed. (auth)

16358 (WANL-PR(J)-034) WESTINGHOUSE ASTRONUCLEAR LABORATORY, NERVA NUCLEAR SUBSYSTEM. Progress Report, July 1, 1964–September 30, 1964. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Oct 1964. 353p. Dep. NTIS $20.75.

Declassified 10 Sep 1973.

The first power test of a NERVA reactor (NRX-A2) was conducted. After preliminary fluid flow, nuclear control, and scaled-down power checks, the reactor was ready for power testing on the 24th of September. The objectives were three-fold: To obtain data verifying the steady state design and analysis for power operation; to obtain data on reactor operation at the steady-state power level and at the temperature expected in an experimental engine system; and to verify that the reactor can not only start, but also operate at steady state, and then shutdown. After the power test, preparations were made for a restart and a low power — low flow mapping experiment. From a review of the test and early analysis of data, it appears that all test objectives were successfully met. Other activity consisted of the release of manufacturing drawings for the NRX-A3 and NRX-A4 reactors. The components in these two reactors are basically of NRX-A2 design, refined and modified on the basis of component tests, PAX tests, and NRX-A1 cold flow tests. Major component tests included vibration testing of a complete reactor, structural tests of the graphite reflector, and fuel element studies. In the vibra-

tion test the reactor was enclosed in a pressure vessel and suspended in the down firing position from four low frequency mounts. Three thrusters were attached to a drive cone and used to vibrate the reactor at the nozzle flange directly beneath the inner reflector. In the structural test of the graphite reflector, the integrity of the graphite barrel under compressive stresses up to 5000 psi was verified. In the fuel element studies the effectiveness of present coating techniques in preventing corrosion of fuel elements was established. PAX tests continued. The PAX control drums were removed for final assembly, instrumentation, and installation in the NRX-A3. (auth)

16359 (WANL-PR(J)-038) NERVA NUCLEAR SUBSYSTEM. Progress Report, April 1, 1965–June 30, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Jul 1965. 220p. Dep. NTIS $14.00.

Declassified 10 Sep 1973.

The major activity was the series of NRX-A3 Power Tests at NRDS. The refurbished turbo-pump operated at the NRX-A3 design point with the performance meeting predictions. All major objectives were met. The tests are described in detail, including abnormal behavior which caused an automatic shutdown during which excessive tie rod temperatures developed. Work continued on the NRX-A4/EST, the NRX-A5, the NRX-A6, and the XE-1 Reactors. With the exception of fuel clusters, the NRX-A4 reactor was virtually complete. The major components for the NRX-A5 reactor were received, including the control drums, outer reflector, and inner reflector. As now defined, the NRX-A6 includes considerable design flexibility to permit changes as additional test results become available. The basic concept is that of an outer reflector made up of three concentric rings, a counterflow tie rod support for the fuel clusters, an aft end support cone for reactor axial support, and a segmented graphite seal system between the core and outer reflector. There is no graphite inner reflector as in previous designs. Spring loaded plungers are housed in the outer reflector rings to provide lateral support. (auth)

16360 (WANL-PR(J)-043) NERVA NUCLEAR SUBSYSTEM. Summary Progress Report, 1 October 1965–30 September 1966. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Oct 1966. 111p. Dep. NTIS $8.75.

Declassified 11 Sep 1973.

Significant results included the successful completion of reactor test series—the NRX-A4/EST and NRX-A5, and the identification of important areas which require concentrated future effort. For the NRX/EST reactor one objective was to test a breadboard nuclear rocket engine system using a hot bleed port nozzle; a second was to determine reactor power operation duration capability. The reactor was operated at full power on three occasions in March for a cumulative total of 29.5 minutes at nominal rated temperature. Reactor power mapping measurements were made over a range of chamber temperatures and pressures to determine power and flow-rate values; also control transfer functions were measured at several temperatures. In summary the NRX/EST test series demonstrated the feasibility of hot bleed cycle nuclear engine system and of bootstrap startup to any desired power level. However, post-operational examinations of the core confirmed that reactivity loss was due to hydrogen corrosion of the fuel elements, although no significant structural damage was sustained. The primary objective of the NRX-A5 test series was to determine reactor operational duration capability; others were to demonstrate feasibility of a "no-flux loop" (i.e., without a nuclear power feedback loop) temperature controller, a fixed control drum startup from low to high power, and to obtain more precise data on the radioactive effluent discharged from the reactor. Total power operation for both tests exceeded 1000 MW for 30.4 minutes at or near rated conditions. Startup from low power to near rated conditions was accomplished using propellant hydrogen reactivity with control drums held in a fixed position. The drums were then rotated outward to increase power and, after full power was held for 14.3 minutes, shutdown was initiated upon reaching a predetermined drum position of 145 degrees. Upon disassembly in mid-August, examination showed that, except for core corrosion similar to the NRX/EST condition, the test assembly components were in good condition. Based on the information from the NRX/EST and NRX-A5 performances and on fuel element component testing, certain NRX-A6 redesign studies were initiated to obtain a more favorable fuel element environment and thorough reviews were initiated of all phases of the fuel element fabrication process, raw materials, and reliability testing techniques. (auth)

16361 (WANL-PR(J)-045) NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 January 1967–31 March 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Apr 1967. 184p. Dep. NTIS $12.25.

Declassified 11 Sep 1973.

Encouraged by the recent successful tests of the Phoebus 1B, a steady effort was directed toward the early testing of both the XE-1 and NRX-A6 reactors. The fuel development and assessment program continued. More than 500 single element hydrogen corrosion tests were conducted. Present plans call for a late August testing of the NRX-A6 reactor. Shipment of the XE-1 reactor took place on 10 April 1967. Testing is officially scheduled for October 1967. XE-2 fuel production will continue immediately after completion of NRX-A6. (auth)

16362 (WANL-PR(J)-046) WESTINGHOUSE ASTRONUCLEAR LABORATORY, NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 April 1967–30 June 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Jul 1967. 180p. Dep. NTIS $12.00.

Declassified 11 Sep 1973.

Shipment of the XE-1 reactor took place on 10 April 1967, the assembly reaching Las Vegas, Nevada on schedule. It was delivered to the test site without incident. Assembly into the XE-1 engine test article is proceeding in the E-MAD facility. Fuel production for the XE-2 reactor has begun. Expedited procurement of hardware for this reactor is under way. The NRX-A6 reactor was being readied for shipment in mid-August 1967. WNCO fuel production was essentially complete; Y-12 efforts were nearing completion. Test of this reactor is scheduled for November 1967. A design review was held at WANL on 25 May 1967, leading to satisfactory resolution of outstanding questions. The prerequisite component tests of exit gas thermocouples and LASL clusters have been completed. The NRX-A6 critical experiment utilizing the actual reflector was initiated and completed. The NRX-A7 reactor is planned as a Test Bed Reactor to demonstrate NR high-void-fraction-type fuel element endurance at NR specification conditions of power, temperature and duration. It will serve as a bridge between the Technology Program and the NR program. Procurement of hardware and development of fuel has begun. The PFRT Development Plan was prepared, published and distributed. Hardware design and development testing has begun on the 4200 MW NR reactor to be developed, tested, and incorporated into the NE (NERVA Engine) Pre-Flight Rating Tests (PFRT). (auth)

16363 (WANL-PR(J)-050) NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 April 1968-30 Jun 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jul 1968. 195p. Dep. NTIS $12.75.

Declassified 11 Sep 1973.

Detailed reports relative to the successful test of the NRX-A6 nuclear subsystem were completed. Extensive testing of fuel elements continued. An experimental side-by-side test will be set up using WANL and LASL groups. Both groups will be exposed to the same environmental conditions as PeWee 1 up to final testing. At selected times, elements will be hot gas tested to determine changes in the quality. PeWee 2 fuel element characteristics transmitted to LASL include matrix composition coating weights, coating compositions and void fraction. While the maximum loading of PeWee 2 has been targeted to the maximum loading for R-1, it is still subject to necessary reactivity experiments and calculations by LASL preparatory to a final loading. Plans and schedules are being made with the fuel committee relative to Y-12 and WANL Q-coating of elements and the GTX experiments. The XE-1 control drum actuator and scram system is the subject of a continuing study. WANL is now investigating (subject to NTO schedule determination) the installation of a closed loop scram system. The XE-2 reactor was shipped by WANL on 10 June 1968. Reactor-oriented documentation relative to XE-2 will be distributed shortly. Delivery of actuators, pedestals and drive shafts for XE-2 are being phased behind XE-1 actuators. NERVA-1 engineering effort continues with emphasis on layout drawing and analysis-type reports. An Engineering Data and Design Review is scheduled for mid-July 1968. (auth)

16364 (WANL-PR(J)-057) NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 January 1970–31 March 1970. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Apr 1970. 64p. Dep. NTIS $6.24.

Declassified 11 Sep 1973.

The engineering analysis required for the XE prime final test report was completed. Major activity on the NERVA design was aimed at arriving at a configuration to be used for DRB submittal and for on-going analysis leading to PDR. Trade studies were completed in all ECC design areas and for all system aspects. Major design systems conclusions were made. Studies were completed relative to effluent problems both in ground test and in flight test. Major conclusions are that the frequencies of testing anticipated in the NERVA program, when combined with fission product loss from the newer fuels, will require strong consider-

ation of scrubbers at the test site. Studies of the fission products in space flight do not indicate major problems relative to operations. The PEWEE-2 prime element fabrication was completed through NbC coating by the end of March. Plans and schedules were completed for transferring LASL composite element production to WNCO. (auth)

16365 (WANL-PR(J)-060) NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 October 1970–31 December 1970. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jan 1971. 86p. Dep. NTIS $7.50.

Declassified 11 Sep 1973.

The major emphasis was to achieve the engineering required to publish the NSS PDR data items. Recommendations for proceeding were made in all areas, and it was further recommended that effort be concentrated on achieving, as rapidly as possible, a "reference detail drawing package." Systems Analysis effort was initiated to support the engine design review meeting and on the impact of the 400E engine design review meeting and on the impact of the 400E engine on the nuclear subsystem. The fuel effort has been directed toward an R-1 element made from Varcum bound GLC 1074 flour. These elements are showing superior performance in relation to other material systems in corrosion tests up to 300 minutes with tests being terminated because of chucking effects at the hot end. The effects of PyC impregnation on these elements are being evaluated. Process parameters, particularly coating and graphitization, are being established in preparation for production of elements for engineering evaluation. Major WANL efforts were applied to defining NSS test objectives and facility modifications required at NRDS for the NERVA Reactor Tests. Engineering efforts were initiated toward the definition of facility requirements for long-lead facility modifications. Based upon the WANL review of Pewee 2 procedures and other related activities, approval was given for the Pewee 2 assembly and pre-test operations. A preliminary Nuclear Furnace Malfunction Analysis was performed and forwarded to NRTO as initial input to continuing WANL effort on an extensive detailed analysis. (auth)

16366 (WANL-TME-059) SUMMARY OF NUCLEAR INFORMATION FOR PRELIMINARY B-1 FLIGHT DESIGN. Krug, H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Apr 1962. 87p. Dep. NTIS $7.50.

Declassified 10 Sep 1973.

The best available values for reactivity worths, control parameters, radial and axial power distributions, and heating rates for the NERVA B-1 rocket reactor are presented. The NERVA B-1 core is the same as that of the KIWI B-1B. There are differences in the graphite reflector designs but these are minor from a nuclear standpoint. The NERVA B-1 geometry includes a shield worth approximately $0.30 whereas the KIWI geometry does not include a shield. Certain important nuclear parameters are summarized. Reactivities measured at various stages of the LASL test program on the KIWI B-1A are listed. The anamolous reactivity behavior of the KIWI B-1A has not been completely resolved to date. Better calculation methods may be required. The use of a nuclear model which represents, with sufficient accuracy, the neutronic conditions within the reactor is to be preferred with respect to a procedure which requires artificial normalization. This is true because perturbations, such as temperature changes and changes in the positions of control vanes, may destroy the relation between the physical and nuclear models. The nuclear representation of the control vanes is one of the most important nuclear problems at the present time because of the intimate coupling between the vane positions and reactivity, power peaking, and control system requirements. Work is in progress to obtain a more accurate nuclear representation for the vanes based upon a two dimensional approach. Another area in which substantial methods improvement is required is in the calculation of temperature and power coefficients. (auth)

16367 (WANL-TME-074) RADIATION EFFECTS PROGRAM. Faught, H. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Jul 1962. 28p. Dep. NTIS $4.50.

Declassified 10 Sep 1973.

The bulk of NERVA Irradiation Tests cannot be accomplished at existing facilities without modification. In general, all of the existing irradiation facilities are deficient in one or more of the following areas: Flux levels are too low to satisfy test requirements; capabilities to fulfill cryogenic or other non-nuclear environmental test conditions are limited or completely lacking; inadequate space to accommodate test specimens and associated instrumentation; and/or no provision to permit the insertion or removal of test specimens during reactor operation. Existing test facilities are reviewed to determine possible modifications to accommodate the NERVA Irradiation Program. (auth)

16368 (WANL-TME-320) PROJECT NERVA, REACTOR ANALYSIS. Pre-assembly Experiment (PAX) Design and Assembly Procedures. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Apr 1963. 32p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

The NRX-A reactor, has undergone numerous design changes which lead to reactivity differences that cannot be resolved by existing analytical and experimental information. The Proof Test Experiment (PTX), which will be performed on the fully assembled NRX-A reactor, also can not provide the resolution since access to this fully assembled reactor is severly limited. This is due to the tight lateral support, interlocking support blocks and cluster tie rods which are bolted to the core support plate. An experiment called the Pre-Assembly Experiment (PAX) since it will be performed prior to the final assembly of the NRX-A reactor has been developed. The application of this experiment can be applied to any NRX reactor as required by design, but is basically considered for the first reactors of specific series or types or as dictated by the capability to maintain fuel element uranium inventory by the vendor. The experimental design provides a high degree of physical flexibility in the core of the NRX reactor while maintaining a minimum nuclear deviation from the final assembly. (auth)

16369 (WANL-TME-329) NUCLEAR ANALYSIS OF THE ACCEPTABILITY OF THE KIWI B-6A FUEL ELEMENTS FOR NRX-A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1963. 25p. Dep NTIS $4.25.

Declassified 11 Sep 1973.

The feasibility of utilizing the KIWI B-6A fuel elements for the central zone of the NRX-A-2 has been investigated. The KIWI B-6A fuel elements are of the oxide type as contrasted with the beaded fuel elements being developed for NRX-A-2. The analysis indicates that the reactivity of the NRX-A-2 employing the existing KIWI B-6A fuel elements as the central zone loading is marginal. The pressure drop across the core is estimated to be 135 psi as contrasted with 129 psi for the NRX-A-2. This increased pressure drop would result in a proportional increase in core structure stresses. (auth)

16370 (WANL-TME-333) PRELIMINARY MEASUREMENT OF LOSS COEFFICIENT FOR THE BERYLLIUM REFLECTOR ASSEMBLY FLOW TESTS. Bouille, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 May 1963. 21p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

Cooling of the beryllium reflector of NERVA reactors is effected by hydrogen flowing through a series of passages covering the entire length of the reflector. The hydrogen is introduced through holes in the lower support ring, flows through the reflector and is exhausted through holes in the upper support ring. The results of flow tests on a segment of the beryllium reflector assembly are presented. Areas investigated were: The effect of the hole size and geometry on pressure loss coefficients for the dome end and nozzle end support rings; the effect of inlet and exhaust configuration on the pressure drop across the reflector; and the pressure distribution and flow patterns in the thin plena between the support ring and the reflector. Tests were conducted using air at ambient temperature and 90 to 120 psig inlet pressure. (auth)

16371 (WANL-TME-337) NRX-A-1 KINETICS PARAMETERS. Krug, H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Feb 1963. 11p. Dep NTIS $4.00.

Declassified 11 Sep 1973.

Kinetic parameters have been developed for preliminary analysis of the NRX-A1 reactor. These include reactivity values for the hydrogen content, temperature changes, core expansion, Doppler effect, control drum changes, delayed neutrons, etc. (LTN)

16372 (WANL-TME-338) TIME DEPENDENT REACTIVITY PROFILE ANALYSIS. Krug, H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Jan 1963. 12p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

New, time-dependent reactivity profiles for NRX-A reactors are presented, which use the latest reactivity coefficients and include consideration of the Doppler effect and adsorbed hydrogen. They also allow for design changes to suppress the axial power peak, reduced hydrogen in the lateral support region and differences between NRX-A and KIWI reactors (some of the measurements were made on the latter). (LTN)

16373 (WANL-TME-391) REQUIREMENTS FOR UNLOADED GRAPHITE CORE ELEMENTS FOR WANL DESTRUCTION CORE TEST. Fields, C. C. (Westinghouse Electric Corp., Pittsburgh,

Pa. (USA). Astronuclear Lab.). 15 Nov 1963. 92p. Dep. NTIS $7.75.
Declassified 11 Sep 1973.
The specifications for unloaded graphite fuel elements and other graphite core components are detailed. These materials are required for a core destruction test. Considerable effort has been expended to ensure as far as possible that the unloaded graphite elements are made the same way as standard components, meet all the required tests, etc. (LTN)

16374 (WANL-TME-392) EFFECT OF TIE-RODS ON THE NRX-A CORE LATERAL DEFLECTION. Downs, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1963. 39p. Dep. NTIS $5.00.
Declassified 11 Sep 1973.
The lateral deflection of the core for a steady lateral acceleration is approximately 6% greater at the nozzle end when the tie rod effect is considered. (auth)

16375 (WANL-TME-396(Rev.A)) PRELIMINARY MODEL SPECIFICATION, NERVA NUCLEAR SUBSYSTEM. Model NRX-A for Engine, Rocket, Nuclear, Shielded, Hot-Bleed, Model No. AJ30-5. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1963. 94p. Dep. NTIS $7.75.
Declassified 10 Sep 1973.
This specification covers the requirements for the model NRX-A NERVA Nuclear Subsystem of the AJ30-5 Shielded Nuclear Rocket Engine (FX Series) identified by Aerojet-General Corporation (AGC) specification 10095D. The Nuclear Subsystem is a hydrogen-cooled, graphite-moderated, intermediate neutron energy reactor. It is designed to supply the AJ30-5 engine nozzle with 71.6 lbs/sec of hydrogen of 4090°R and 550 psia as well as bleed flows for turbine drive, tank pressurant, pneumatic actuation and components coolant. The Nuclear Subsystem consists of the following assemblies: The core assembly, the outer reflector assembly, the shield assembly, the screen assembly, the anitcriticality poison system and the reactor control system. (auth)

16376 (WANL-TME-398) DESIGN SIGNIFICANCE OF COMPONENT TESTS. Miller, A. I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1963. 22p. Dep. NTIS $4.25.
Declassified 10 Sep 1973.
The thermal and fluid flow areas of the component test program fall into several categories of generally different character: Tests to supply data necessary for the sizing of flow control orifices and other impedance devices; tests to determine the physical capabilities of critical sections to withstand thermal stresses and hydraulic loads; tests to determine distribution of coolant in critical areas; tests to determine the effects of self-excited or forced vibrations; tests to check the real performance of critical components; and tests to provide basic data on heat transfer and fluid flow to permit improvement of analytical techniques. The results obtained to date from this test program and their design significance are summarized. (auth)

16377 (WANL-TME-425) DATA FOR NRX-A2 DESIGN REVIEW. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1963. 212p. Dep. NTIS $13.75.
Declassified 10 Sep 1973.

16378 (WANL-TME-471(Suppl. 1)) NRX-A SHIELD REPLACEMENT UNIT, STRESS AND VIBRATION ANALYSIS. Pianka, E. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1964. 16p. Dep. NTIS $4.00.
Declassified 10 Sep 1973.
This analysis determines the stress induced in the NRX-A aluminum replacement shield flange due to interaction with the pressure vessel and dome end support ring during a steady-state, full power operating condition. The calculated value was found to be acceptable when compared to the material yield strength at the operating temperature. (auth)

16379 (WANL-TME-483) NRX-A REACTOR MODEL FOR SYSTEMS ANALYSIS. Knecht, W. L.; Howarth, W. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Jul 1963. 38p. Dep. NTIS $5.00.
Declassified 10 Sep 1973.
The NRX-A reactor model used by WANL for systems analysis is described. This model is currently in use with the TNT code to calculate reactor performance during the startup, steady state, and shutdown phases of reactor operation. (auth)

16380 (WANL-TME-484) INTERRELATIONSHIP OF FACTORS AFFECTING SHIELD DESIGN CRITERIA. Woodsum, H. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1963. 34p. Dep. NTIS $4.75.
Declassified 10 Sep 1973.
The interrelationship of factors affecting the shield design for a NERVA vehicle is summarized in schematic form to show all of the direct and indirect ties between the factors. These factors and their interrelationships are explained and, after some discussion, two factors of major significance in shield design are selected: The maximum allowable coolant (propellant) temperature rise, and the engine and payload radiation environment restrictions. An alternative to setting these two quantities is to specify the maximum allowable radiation limits at all points outside the reactor. An overall optimization requires the consideration of several other factors and is mission dependent. (auth)

16381 (WANL-TME-491) SUMMARY OF NERVA INSTRUMENTATION REVIEW MEETING AT SNPO-C, AUGUST 13–14, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Aug 1963. 272p. Dep. NTIS $16.75.
Declassified 10 Sep 1973.

16382 (WANL-TME-568) STRESS ANALYSIS: NRX-A CLUSTER TIE ROD. Downs, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1963. 45p. Dep. NTIS $5.25.
Declassified 11 Sep 1973.
The stress analysis of the NRX-A tie rod considers both the non-operating and full power steady state operating conditions. It indicates that the tie rods will function properly and sustain the anticipated core loads. However, since the local bending strain at the core inlet end could be high and because the tie rods are one of the most critical components, a low cycle fatigue test is recommended. (auth)

16383 (WANL-TME-571) EVALUATION OF ORIFICE CEMENTS FOR NERVA. Nicholson, H. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Feb 1964. 27p. Dep. NTIS $4.50.
Declassified 11 Sep 1973.
An investigation of adhesives suitable for bonding 304 stainless steel orifices in the gas flow channels of NERVA graphite fuel elements is reported. Based on this evaluation, Silastic RTV 891, a silicone rubber adhesive, demonstrated the best combination of properties. The joints did not leak when pressure-tested with 50 psi at the following temperatures: –320°F(–196°C), at 78°F(20°C), and after exposure to 550°F(288°C) with subsequent leak testing at room temperature. The adhesive is not adversely affected by irradiation doses up to 6×10^{16} nvt. (auth)

16384 (WANL-TME-586) NRX SAFETY ANALYSIS REPORT. Draft Version. Vachon, L. J.; Cleary, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1963. 65p. Dep. NTIS $6.25.
Declassified 11 Sep 1973.
The special siting requirements for full-scale static testing of NRX-A reactors are generally satisfied by the NRDS site. Certain meteorological characteristics, particularly the nocturnal drainage phenomenon, present some difficulties in the control of radiological hazards. It has been concluded that the dose accumulated by off-site personnel will be less than the MPD provided that, operation is restricted to lapse conditions and reactor shutdown from a power run precedes the occurrence of nocturnal drainage by one to two hours. The radiation environment during normal test operations is significant only during a full power run. During such a test, direct radiation levels are acceptable at the Control Point and MAD building but marginal at Test Cell C; the use of roadblocks at appropriate points is essential for the profection of site personnel against high neutron-gamma doses. The residual gamma radiation from the reactor following a full power test prohibits access to the test cell for several hours after shutdown. The radiological hazards associated with the normal release of fission products to the atmosphere impose certain meteorological restrictions on a full power test: reactor operation is not acceptable under inversion conditions regardless of wind direction and shutdown must occur one to two hours prior to sunset due to the nocturnal drainage phenomenon. The external gamma dose received during passage of the effluent cloud is not significant for either site or off-site locations. The consequences of a nuclear accident during low power experiments are not significant due to the remote location of the test cell. Ground-level release of the entire fission product inventory from 4×10^{22} fissions is postulated as the maximum credible accident; this incident could occur at the end of a full power test and result from a loss of coolant or a malfunction in the control system followed by a reactor excursion. Although dose levels are significant under lapse conditions, serious consequences for site and off-site population would result if such an accident were to occur under inversion conditions. Suitable safeguards and/or countermeasures to prevent such a combination of accident and meteorological conditions are required. (auth)

16385 (WANL-TME-606) EVALUATION OF URANIUM DICARBIDE FUELS. Theis, D. E.; Tobin, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Nov 1963. 38p. Dep. NTIS $5.00.

Declassified 11 Sep 1973.

Recent results of an experimental program of evaluation of pyrocarbon coated uranium dicarbide particles are presented: Results of tests performed on production and developmental lots of coated particles, and summarized results of detailed studies of uranium migration in coated particles. (auth)

16386 (WANL-TME-679(Pt.2)) GADOLINIUM–STAINLESS STEEL DEVELOPMENT. Part II. Begley, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Feb 1964. 43p. Dep. NTIS $5.25.

Declassified 12 Sep 1973.

Fabrication procedures were developed to produce AISI 304 stainless steel + 1 w/o Gd_2O_3 strip for neutron absorbing cluster plates. Large powder compacts were directly hot rolled to finish gage. Evaluation showed that hot rolled, annealed material meets the mechanical property requirements for cluster plates over the desired temperature range of −160 to 1000°F. Although the notched tensile properties in the transverse direction are low, they are considered adequate. Cold worked material exhibited improved notched properties, but marginal ductility at room temperature and above render this material unsuitable. Prohibitive radiation damage is not expected at the flux environment of cluster plates for a 20-minute NERVA hot test. A problem with chemical homogeneity has only recently been solved by lengthening the blending time. (auth)

16387 (WANL-TME-711) CORE GAMMA RAY HEATING RATES IN THE LI H-SS FLIGHT SHIELD COMPUTED BY MONTE CARLO PROGRAM 18-0. Capo, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 Mar 1964. 21p. Dep. NTIS $4.25.

Declassified 12 Sep 1973.

The rate of radiation heating in the lithium hydride-stainless steel flight shield due to core gamma rays has been computed by Monte Carlo Program 18-0. Comparisons between Monte Carlo data and point kernel Program 14-0 heating rates are also presented in graphical form. The point kernel results are consistently higher than the Monte Carlo data by factors ranging from 1.05 to 1.9. The greatest differences occur where the heating rates are relatively low; in regions close to the reactor, where the heating rates are high, the two methods are in essential agreement. (auth)

16388 (WANL-TME-715) EXPERIMENTAL DETERMINATION OF THE CONTROL DRUM-DRIVE SHAFT LOSS COEFFICIENTS USING AIR. Test Series FFL-8. Jacob, W. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Apr 1964. 144p. Dep. NTIS $10.25.

Declassified 12 Sep 1973.

Pressure loss coefficients are required along the control drum and drive shaft coolant flow paths for design and off-design conditions. Flow distribution through the bearing shafts, the control drum, the flexible couplings, and the drive shaft must be determined. Measurements of the loss coefficients and flow distribution is necessary so that the correct sizing of the drive shaft discharge holes, nozzle end plenum inlet holes, nozzle end control drum plenum, and the other tortuous coolant passages can be achieved. This knowledge is necessary to insure a safe thermal environment for the control drum assembly and drive shaft innards during maximum power output of the NRX-A hot tests. A test model consisting of a mock-up of the center two rings of the control drum cooling holes in series with the bearing shafts and the control drum drive shaft including all necessary accessories (retaining nuts, spacers, couplings, half-rings) was fabricated, instrumented, and an air flow test program initiated. The test model instrumentation includes total and static pressure probes and temperature probes. The experience and knowledge gained from the instrumentation of this model can be used as a guide for the most effective utility of the available instrumentation locations of a complete control drum model which contains all of the other coolant passages. The experimental results are summarized. (auth)

16389 (WANL-TME-716) EFFECT OF NRX-A FULL POWER RUN TIMES ON FACILITY FLUID REQUIREMENTS. Goldberg, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 Apr 1964. 18p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

The fluid storage requirements (LH_2, GH_2, GHe and GN_2) of Test Cell "A" are estimated for NRX-A reactor full power run times (5, 10, 15, and 20 minutes) and various methods of reactor shutdown and cooldown. (LTN)

16390 (WANL-TME-725) EFFECTS OF ELECTRICALLY SIMULATED NUCLEAR TRANSIENTS ON GRAPHITE TYPE FUEL. Roll, J. A.; Meyer, L. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 1 Apr 1964. 22p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

Two series of tests on the electrical simulation of nuclear transients were performed. The first test series determined that temperature measurements were not required in transient testing of graphite samples with a pulse of 0.016 second duration. The second series disclosed deficiencies in the experimental equipment. A new design of test sample holder is proposed and a tentative schedule for additional tests is offered. It appears that fragmentation will occur at a heating rate of approximately 135,000 calories/g/sec. (auth)

16391 (WANL-TME-803) RADIATION TESTS OF A TIE ROD STRUCTURE ASSEMBLY FOR NERVA FUEL. GTR Test No. 8. Zorn, J. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Jun 1964. 71p. Dep. NTIS $6.75.

Declassified 10 Sep 1973.

Four non-fueled cluster assemblies simulating NERVA design were irradiated under controlled environmental conditions at the Ground Test Reactor in Ft. Worth, Texas, to evaluate the serviceability of the Inconel X-750 tie rods and other support devices currently under consideration for use in the NERVA reactor. Two instrumented and two non-instrumented tie rods, shortened in length, were integrated into four cluster assemblies. Maximum operating temperatures and load conditions were imposed on these assemblies during irradiation. After irradiation, the clusters were disassembled and inspected for damage; the tie rods were subsequently tensile tested along with control specimens and metallography was performed. In general, all the rods and associated cluster hardware withstood the irradiation test without detrimental effects. Anomalies observed were satisfactorily explained or at least found attributable to other phenomena not involving radiation effects mechanisms. The greatest single anomaly, which remains unresolved, is the apparent increase in elongation of the irradiated specimens over the unirradiated control samples. (auth)

16392 (WANL-TME-808) NRX-A5 REACTOR ANALYSIS. Design Release Report. Black, D. L.; Buskirk, D. L.; Cort, G. E.; Davidson, S. L.; Guzek, J. C.; Minners, W.; Vijuk, R. M.; Stefanko, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jun 1964. 98p. Dep. NTIS $8.00.

Declassified 10 Sep 1973.

The results of design analysis studies have led to a design release on certain components of the NRX-A5 reactor. The design objectives were to improve the life, reliability, and performance capability of the reactor. However, because no hot test has as yet been performed on a NRX-A type reactor, only changes based on analysis, component tests or KIWI experience were incorporated. Major aspects of the design analysis involved the inner reflector and lateral support system, the core band, selective assembly of fuel elements, reduction of power factor range, preferential orificing of core peripheral regions, the use of unfueled tips and as-extruded elements, tie rod bushings and liners, and an improved fuel loading scheme. (auth)

16393 (WANL-TME-816) A-11 SEVEN CLUSTER MODEL: PHASE V, FLOW INDUCED VIBRATION TESTS. Cherish, P.; Leff, G. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Sep 1964. 71p. Dep. NTIS $6.75.

Declassified 10 Sep 1973.

When a model is employed to obtain data for prediction of the pressure distribution in, and the vibration characteristics of, a full scale unit, a degree of uncertainty is always present regarding the usefulness of the model test data. In the A-11 Phase V test, experimental data were obtained from tests on a seven cluster reactor model which incorporated as many of KIWI B-4A design features as could reasonably be included in the NRX-A reactor envelope. The data obtained was compared with data from a pie sector, full scale reactor test. From this comparison, it appears that the results obtained from the seven cluster model are reasonable, within the expected limitations, and insure confidence that stable operation of the NRX-A reactor can be expected, based on the NRX-A model tests (Tests A-11 Phases I, III and IV) performed earlier. (auth)

16394 (WANL-TME-817) STRESS ANALYSIS: NRX-A2. Eggers, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 45p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

The analyses performed to determine whether the NRX-A2 reactor is structurally capable of withstanding the conditions which will be imposed on it during the forthcoming test are

summarized. Each major component of the reactor was examined carefully to identify potential problems that might occur during the test. Special emphasis was placed on evaluating problems that occurred during the NRX-A1 test series, including the effects which hardware modifications and run profile differences would have on those problems. The reactor core components are most difficult to analyze, but the successful KIWI B-4D test indicates that the nearly-identical NRX-A2 components should be satisfactory. It was concluded that, for the run profiles specified, there is no condition sufficiently severe to prevent the test from being successful. However, there are eight problem areas which warrant special mention. Methods of minimizing the problems in these areas by temperature limits for some components, design changes already made, or by special operational procedures are summarized. (auth)

16395 (WANL-TME-823) CORE TIE ROD SIMULATING EXTREME OPERATING CONDITIONS. Kotulak, F. M.; Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 23p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

The wide extremes of temperature experienced in the operation of the NERVA reactor, especially during startup and shutdown, will, due to thermal growth and the variable coefficients of expansion in the different materials used, induce severe stresses in the components. There is concern that bending stresses imposed on the already highly stressed tie rod could induce premature failure in the tie rod, which would then adversely affect successful reactor operation. Tests were conducted to substantiate analytical work and prove that the tie rods will perform satisfactorily under the extreme load conditions encountered during reactor startup and shutdown. The calculated mean stress for a tie rod with zero offset and maximum axial load of 820 lb was found to be approximately 85,000 psi. With a 0.200 inch offset and the maximum axial load of 820 lb, the maximum localized stresses induced are well beyond the yield strength. Actually, at this same axial load yielding will occur in the tie rod at less than 0.100 inch offset. The tie rod can be offset approximately 0.175 inches before yielding will occur with an axial load of 600 lb. After the first cycle at maximum load and offset conditions practically no further yielding was evident after 25 additional cycles. The test data indicates that the tie rod will perform satisfactorily during the life of the reactor. If this durability is typical of all tie rods, the safety factor is considerable, since the maximum anticipated offset is substantially less and the maximum number of cycles are less than 100 at this condition. (auth)

16396 (WANL-TME-825) EXPERIMENTAL DETERMINATION OF THE OUTER IMPEDANCE RING LOSS COEFFICIENTS USING AIR. Test Series FFL-7. Jacob, W. L.; Morrison, H. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jun 1964. 24p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

Air flow tests conducted on a stainless steel model of the outer reflector pressure vessel impedance ring are summarized. The impedance ring segment consisted of six 0.1135-inch diameter holes. The results are presented in two parts: Loss coefficient versus Reynolds number, and annulus friction factor versus Reynolds number. The loss coefficient includes the losses from the annulus upstream of the six support ring holes to the exit plenum for the first pass of the shield. (auth)

16397 (WANL-TME-847) JOINING OF GRAPHITE FUEL ELEMENTS FOR THE NRX-B ADVANCED DESIGN. Nicholson, H. C.; France, L. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Jul 1964. 59p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

A process has been developed for fabrication of cemented fuel element clusters for the NRX-B design effort. Both seven and nineteen element clusters in twelve-inch lengths have been produced from graphitized, unfueled WANL and ORNL elements. Transition blocks of ATJ graphite were also cemented to the clusters. Limited thermal shock tests on these clusters had no effect on them. Since this project was terminated, this process was not extended to fabrication of full length fueled element clusters. However, the state-of-the-art for cluster fabrication from as-graphitized and as-extruded elements, the mechanical strength of graphitized P-514 cemented joints from room termperature to 4532°F (2500°C), the effect of a NbC coating on the tensile strength of graphitized P-514 joints, and other information accumulated during this study are recorded. (auth)

16398 (WANL-TME-848) NRX-A2 ELEMENT PLACEMENT AND ORIFICING. Summary Report. Guzek, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 62p. Dep. NTIS $6.25.

Declassified 11 Sep 1973.

Tables, a schematic cross section, and computer output sheets which summarize the core assembly of the NRX-A2 (ND 10202) reactor build are presented. The procedure for specifying orifice placement in the NRX-A2 core is described in WANL-TME-871. Fuel element variations from design specifications which involve thermal considerations have been identified and grouped into ten categories. Many of these were subsequently remachined to meet specifications. (auth)

16399 (WANL-TME-871) NRX-A CORE ORIFICING. Guzek, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 87p. Dep. NTIS $7.50.

Declassified 11 Sep 1973.

The procedure for orificing NRX-A type reactors is described. The hydrogen propellant flow is distributed proportionally among 30,600 fueled channels by the use of stainless steel tube-type orifices. Each orifice is selected on the basis of its consistency with channel power level and measured characteristics to achieve a uniform core exit gas temperature. The core pressure drop is determined by the channel which, because of its power level and measured channel diameter, presents the greatest flow impedance. The largest available orifice size, 0.070 inch nominal flow-hole diameter, is placed in this channel. The orificing procedure utilizes computer codes which provide, in addition to orifice size selection, a data checking routine which minimizes input misinformation. The computer printout is used directly as the basic document for orifice installation and core assembly. Twelve orifice sizes have been identified on the basis of a ± 200°R variance in channel exit gas temperature; the sizes range from 0.0225 to 0.070 inch. All production orifices are flow tested to be within limits of ± 50 R in channel exit gas temperature. Fuel element orifice installations are leak tested for a maximum permissible by-pass flow resulting in a 100 R decrease in channel exit gas temperature. The effect of component test results on orifice performance is discussed. The principal tests were cluster plate proximity, axial and radial displacement, cross flows and heat addition to the orifice. (auth)

16400 (WANL-TME-873) NRX-A1 COLD FLOW TEST PRESSURE OSCILLATIONS. Persin, W. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 13p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The pressure oscillations which occurred during the NRX-A1 cold flow tests have been recorded. The magnitude and frequency of the oscillating pressures are about what would be expected based on the KIWI experience. Due to the low frequency, no dynamical magnification would be expected, or was observed; thus, these transient pressures are deemed to be no more severe in terms of mechanical loading than the same pressures applied statically. The frequency of oscillation was fairly low in the NRX-A1, from 1 to 8 cps. Frequencies in this range are too low to be resonant with parts which feel the pressure oscillations, hence their seriousness is greatly reduced. In addition to the expected pressure oscillations, two very large pressure surges were experienced, one at the termination of the first liquid hydrogen run during EP II, and the other at the termination of the first liquid hydrogen run of EP IV. The cause of these pressure surges are attributed to the introduction of ambient hydrogen gas to the reactor during the warm up period. These pressure surges also caused essentially low frequency pressure oscillations, so the same conclusions apply. (auth)

16401 (WANL-TME-874) WANL FUEL MATERIAL IRRADIATION PROGRAM. Capsule Series T-T (Phase II). Jacobs, D. C.; Glassmire, C. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Jun 1964. 26p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

Modifications have been made to the irradiation capsules, viz., the number of thermocouples to be used and the coolant inlet hose. Consequently, WANL will supply the following new equipment: Flexible metal coolant delivery hose, thermocouple extension cable, and recorder extension cable. The required installations and modifications are described in detail. (auth)

16402 (WANL-TME-876) POTTING OF THERMAL CAPSULES AND THERMOCOUPLES IN THE NRX-A REACTOR. Nicholson, H. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jul 1964. 11p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The development and evaluation of a felt-modified carbonaceous cement for potting of thermal capsules and thermocouples in the instrumented central fuel elements of the NRX-A2 core are summarized. This cement, which is cured at 260°F (127°C), can be heated to 4530°F (2500°C) at a rate of 104°F (40°C)/sec. without deterioration. This rate exceeds the estimated heating

rate during the start-up of the NRX-A2 reactor. The modified cement is recommended for use in the NRX-A2 core. (auth)

16403 (WANL-TME-881) STRESS ANALYSIS: NRX-A NOZZLE INTERFACE SEAL. Henne, E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1964. 34p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

The stress analysis of the NRX-A Nozzle Interface Seal is presented. The results of the calculations indicate that the Nozzle Interface Seal should function adequately at the full power, steady state, operating condition. (auth)

16404 (WANL-TME-884) COMPARISON OF NRX-A2 AND KIWI-B-4D 202 CORE BUNDLING WITH RELATION TO ELEMENT PROBABILITY OF SURVIVAL. Davidson, S. L.; Swanson, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 33p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

The lateral bundling pressure distribution and the probable fuel element failure rate from mechanical, thermal and hydraulic stresses in the NRX-A2 core with its distributed seal system are compared with the KIWI B-4D 202 core with its nozzle end seal and wrapper. It is shown, based on limited experimental data and analysis, that the KIWI B-4D 202 probable fuel element failure rate is greater than the failure rate for the NRX-A2 core. The calculations neglect the stresses resulting from the radial inflow of cold gas from the filler strip region since they are independent of bundling pressure distribution. Comparisons of interelement calculated pressures with measured G-3 pressures indicated reasonable agreement. It was concluded that the concept of a distributed seal is preferable to the nozzle end seal and wrapper due to a lower probable fuel element failure rate. (auth)

16405 (WANL-TME-887) NRX-A2 TEST PREDICTION REPORT. Howarth, W. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 162p. Dep. NTIS $11.25.

Declassified 11 Sep 1973.

The NRX-A2 reactor will be tested at the Nuclear Rocket Development Station with liquid hydrogen to verify the reactor design for steady state operation. "Quick Look" predictions have been calculated for pre-run tests, power test, and post-run tests. The purpose of the "quick look" predictions is to provide data that can be compared with test data displayed on Sanborn recorders so that NTO personnel and/or the Data Review Team can judge during or after the test whether or not the reactor is operating in a normal manner. In addition to normal operating conditions, emergency shutdown procedures and data are given for different types of emergencies, such as: fire, pump failure, etc. (auth)

16406 (WANL-TME-889) REPORT ON DISCREPANT ELEMENTS IN NRX-A2. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1964. 10p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

After the assembly of the NRX-A2 reactor, a review of records showed that two discrepant fuel elements were assembled in the core. The two elements were from coating runs that had been rejected during hydrogen corrosion testing; they had been selected for assembly by clerical errors. An investigation was immediately made which resulted in failure-discrepancy disposition reports (FDDR's) being written to accept the elements for use in this reactor. Attachments to these reports listing the premises justifying the acceptance of these elements are summarized. It was concluded that defective elements should be distinctly marked, stored separately and released from storage only by special procedures. Improvements in key punching and verifying data are also necessary, since such errors allowed the two rejected elements to be used. (auth)

16407 (WANL-TME-892) EVALUATION OF REACTOR-TESTED NRX-A1 INSTRUMENTATION BASED ON POST-OPERATIVE TEARDOWN. Moritz, W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 22p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

The conclusions to be drawn from the NRX-A1 test concerning instrumentation are two-fold: The method of handling instrumentation from incoming inspection at WANL to the Test Stand at NRDS will require detailed review; and the method of installing instrumentation at WANL and testing at NRDS will require detailed review. The disassembly of NRX-A1 revealed that orifices had been plugged by foreign matter, including chips of material, glue or epoxy, wire, paper and tape, and graphite cement. Damage to instruments included bent LVDTs, split shrinkable tubing, pinched leads, and mis-routing. To improve handling methods, all persons working on instrument installation and inspection will be indoctrinated more thoroughly by experienced instructors. Thorough supervision and inspection will be maintained at all times. The reactor's interior will be shielded at all times from all foreign debris, especially during instrumentation installation. Design changes allowing improved installation methods have been made. (auth)

16408 (WANL-TME-897) EFFECT OF ELECTRICAL RESISTIVITY VARIATIONS ON MAXIMUM MATERIAL TEMPERATURES DURING ENVIRONMENTAL TESTING OF NRX-A2 FUEL ELEMENTS. Chi, J. W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Sep 1964. 32p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

Estimates on the maximum material temperatures during environmental testing of fuel elements had previously been based on either an estimated temperature-electrical resistivity relationship, or on the assumption that the heat generated is uniform throughout the fuel element. However, recent experimental data indicate that the actual electrical resistivity may deviate significantly from these assumptions. Based on limited experimental data available on the electrical resistivity of fueled and coated elements (up to 4042°R) and the environmental test data, the electrical resistivities for the entire temperature range of interest have been derived. The results clearly indicate that the resistivity is approximately a constant from 1000 to 3912°R, but drops sharply to approximately one-half the value thereafter. This unexpected phenomenon has been verified by two independent observations. The maximum material temperatures during environmental testing of NRX-A2 fuel elements have been calculated, and it has been shown that for the nominal 4600°R maximum surface temperature tests, 99% of the elements were tested with a calculated maximum material temperature in the range 5013 to 5271°R. The average is 5142°R. The electrical resistivity data provide a heat generation profile that approaches an actual reactor power profile more closely than had been expected heretofore. (auth)

16409 (WANL-TME-902) CORE INSULATION ASSEMBLY THERMAL TEST. Final Report. Kiefer, K. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 41p. Dep. NTIS $5.25.

Declassified 11 Sep 1973.

Pyro-tile surface temperatures in excess of 4500°F, and thermal gradient across the tile of 1800 to 2000°F have been achieved. In addition six thermal cycles from 500 to 4000°F were completed. Each cycle consisted of a thermal ramp from 500 to 4000°F in an elapsed time of three minutes. Return from 4000 to 500°F also required approximately three minutes. Testing was conducted with the core components and pyro-tile subjected to plunger loadings from 0 lb per plunger to a maximum of 100 lb per plunger — in a helium atmosphere of 5 psig. Inspection of the tile and core insulation components after test indicated that they were in satisfactory condition. (auth)

16410 (WANL-TME-918) VIBRATION QUALIFICATION TESTS FOR CONTROL DRUM PNEUMATIC ACTUATORS. Snarponis, W. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Aug 1964. 12p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

Vibration tests for the qualification of pneumatic control drum actuators for use in the XE-1 reactor are defined. This involves a pre-test performance evaluation exposure to the series of vibration conditions for specified times, post-test performance evaluation, post-test inspection for wear, damage or changes and a preliminary and final report. (LTN)

16411 (WANL-TME-958) INTERIM REPORT ON FISSION PRODUCT DIFFUSION CODE (FIPDIF). Cleary, J. D.; Rymer, G. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 54p. Dep. NTIS $5.75.

Declassified 30 Aug 1973.

In order to predict the magnitude of the fission product inventory of an operated NERVA engine under all conditions of interest, a comprehensive computer program is being developed. This program includes the effects of diffusion of the various fission products. The work performed to date in developing the computer program known as FIPDIF is described. In addition, the supporting work used in developing this code is included. (auth)

16412 (WANL-TME-981) REACTOR ASSEMBLY AXIAL VIBRATION TESTS. Summary Report. Ettenson, N. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 27p. Dep. NTIS $4.50.

Declassified 10 Sep 1973.

The reactor assembly axial test series was the second series of tests designed to determine the ability of the NRX-A reactor

to withstand external vibratory loads. A complete reactor, including outer reflector and simulated pressure vessel, was mechanically vibrated. Vibratory forces were applied first at the nozzle flange and then at the pressure vessel flange. The tests were useful in investigating the dynamic interactions of the components, with all boundary conditions properly represented. Vibrational forces up to 2.0 g's were applied to the reactor over the entire frequency band from 10 to 2000 cps. The results are summarized. One of the main objectives was to determine the important resonances of the reactor components. The major resonances encountered are explained. Chattering of the control drums due to bearing clearances was also very evident. Tests were performed to confirm that the bearings were responsible for the harmonics on the accelerometer signals and the control drums were then clamped to produce a cleaner signal which permitted a more accurate determination of system resonances. (auth)

16413 (WANL-TME-994) MECHANICAL DESIGN OF THE NRX-A3 REACTOR. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1964. 47p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

The basic configuration of the NRX-A3 Reactor is similar to that of the NRX-A2 except for modifications to components which have resulted chiefly from a continuation of analyses and investigations at WANL. The major component changes are: An unfueled tip was incorporated on the exhaust ends of the fueled elements in order to obtain a more adherent end coating; the depth of the undercut at the aft end of the fueled elements was decreased to reduce the corrosive effects of hydrogen; an integral key was incorporated on the partial fueled elements and the filler blocks were modified to conform to this change; the length and diameter of the nuclear shims were changed to reduce hydrogen leakage; a new method of securing the end insulating tile to the filler strip was devised; a new split instrumentation ring which facilitates installation and provides better instrumentation lead routing was incorporated; the inside diameter at the aft end of the graphite cylinder was increased to eliminate the possibility of interference between core and cylinder; the nozzle interface seal was changed to facilitate removal and re-installation after the reactor is completely assembled; and the diameter of some of the lateral support plunger pins were reduced to eliminate the possibility of binding in the graphite cylinder. Modifications in instrumentation include changes in installation methods and in areas to be monitored and increases in the quantities of instruments over those required for the NRX-A2 Reactor as well as the addition of entirely new instrument types. (auth)

16414 (WANL-TME-994(Suppl. 1)) MECHANICAL DESIGN OF THE NRX-A3 REACTOR. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1965. 37p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

Evaluation of the NRX-A2 reactor test led to the incorporation of several design changes into the NRX-A3 as follows: Blockage of axial gaps between adjacent tiles on the filler strips, coated peripheral elements, modified instrumentation, O-ring seal in central elements, improved cluster nut disassembly capability, coated bores in 19 central elements and 12 support blocks, and pencil seals added between filler strips in one sector of the core. The support blocks were modified to eliminate interference with the nozzle. All other areas were unchanged. (auth)

16415 (WANL-TME-1007) CALIBRATION TESTING OF NRX-A2 TYPE HIGH TEMPERATURE THERMOCOUPLES AT LASL. Dunn, W. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Nov 1964. 20p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

A calibration test of seven NRX-A2 high temperature in-core thermocouples was performed in the Los Alamos Scientific Laboratory static flow fuel element corrosion furnace. All seven thermocouples behaved well up to about 3600°R. At higher temperatures the measured output dropped adversely below the expected output thus limiting the usefulness of this thermocouple design. A time degradation of the thermoelectric output was shown by those thermocouples tested in a hydrogen atmosphere. The thermocouples tested in helium showed an error at high temperatures but not a degradation. Temperature cycling appeared to be no problem. Although errors were seen at temperatures above 3800°R, several thermal cycles were made and all thermocouples returned to proper calibration whenever the furnace temperature at port five fell below about 3800°R. This also indicates the insulators are responsible for the high temperature errors and degradation seen in these tests and that the tungsten/tungsten-26% rhenium thermocouple wires were not affected. (auth)

16416 (WANL-TME-1019) EFFECT OF NRX-A3 INSTALLATION ON IN-CORE THERMOCOUPLE ACCURACY AND RESPONSE TIME. Gilmour, G. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Oct 1964. 12p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

It is desirable to eliminate the graphite cement used for installation of in-core thermocouples in NRX-A2, at least in hot locations. There is evidence that the cement may not bond properly to the thermocouples and may fail at core operating conditions if not cured slowly during installation. Therefore, various new installation procedures have been proposed which eliminate the carbon cement. The effect on operating characteristics of one of the more promising techniques is discussed. Graphite spacers are slipped over the thermocouple along the length to be placed in the unfueled element. A graphite thimble is forced onto the end of the thermocouple making intimate contact with it. The thimble is as large in diameter as practical for slipping it into the fuel element. The thermocouple assembly is locked in position at the cold end of the core, either by a mechanical fixture or by a cement that can take the environment. The tremendous gamma heating in NRX reactors results in the thermocouples being at higher temperatures than the unfueled elements in which they are located. In order to correctly measure an element temperature, it is necessary to provide a good thermal path from the thermocouple to the element. The expected error at the center of the core is analyzed. The 63% response time in an unfueled element is approximately 6 seconds. The thermocouple follows a temperature change in an unfueled element due to a flow change and leads it if the power changes. (auth)

16417 (WANL-TME-1080) ENVIRONMENTAL TEST METHODS FOR QUALIFICATION OF INSTRUMENTATION TRANSDUCERS FOR USE IN NERVA ENVIRONMENT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 59p. Dep. NTIS $6.00.

Declassified 11 Sep 1973.

This specification establishes uniform methods for environmental qualification testing of instrumentation transducers for use in the NERVA testing program. The test methods described have been prepared for the purpose of specifying suitable conditions obtainable in the laboratory or other testing locations which give test results as nearly equivalent as is practical to actual service conditions, and to obtain reproducibility of the results of such tests. The NERVA environment has been grouped into six environmental zones, each according to severity. A transducer shall be considered as qualified for use in the NERVA testing program when it has met or exceeded all applicable requirements for qualification established for the particular environmental zone in which it is intended to operate. It shall then also be qualified for use in all less severe zones. (auth)

16418 (WANL-TME-1082) NERVA REACTOR DEVELOPMENT PROGRAM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Jan 1965. 99p. Dep. NTIS $8.00.

Declassified 11 Sep 1973.

With the successful testing of the NRX-A2 reactor, the NERVA development program moved forward over a design hurdle in which reactor structural integrity was the major concern to emphasis on the endurance limits of the reactor. Corrosion problems associated with the fuel elements and core graphite parts now require concentrated development efforts. These problem areas are of several types: Bore corrosion; interstitial corrosion; central element corrosion; corrosion at instrumentation interfaces; peripheral corrosion, including fuel elements, filler strips and seal system; and support block-fuel element interface corrosion, including both the fuel element end corrosion and the support block element bonding problem. The key aspects of the above are discussed, and a program identifying the longer range solutions of other problem areas is recommended. (auth)

16419 (WANL-TME-1107) CALIBRATION OF INSTRUMENTED LATERAL SUPPORT SPRINGS AND TIE RODS FOR NRX-A3. Zibritosky, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1965. 32p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

A total of seventeen instrumented lateral support springs and seven tie rods were calibrated prior to assembly in the NRX-A3 reactor. Twelve instrumented springs and six tie rods are installed in the reactor. Strain versus deflection data was acquired for each of the lateral support springs while strain versus axial and flexural load was obtained for each tie rod. In addition, apparent strain measurements were recorded for each spring and tie rod under non-loaded and loaded conditions over the temperature range of −320°F to 400°F. Weldable strain gages were

used. The strap holding down the sheathed leadwire onto the spring failed in several springs at the spot welds. One of the two strain gages attached to one tie rod was faulty and could not be repaired. Comparison of results of the lateral support spring tests shows a large spread between the maximum and minimum gage outputs. The variation from 2600 to 4500 × 10^{-6} in./in. shows that it is necessary to calibrate each gage individually. This variation is much less in the case of tie rods, amounting to about 150 × 10^{-6} in./in. The effect of repeated cycling produces a very small effect. A hysteresis effect was apparent in both tie rod and lateral support spring tests. This amounted to about 2-3% at operating loads in both cases. The linearity of the tie rod data was good up to the maximum limits of the test; however, the lateral support springs deviated from linearity above deflections of 0.25 in. Some differences noted in the lateral support spring calibrations from those performed by Microdot Corporation are reported. Possible explanations are the effects of aging and repeated cycling. (auth)

16420 (WANL-TME-1112) PRELIMINARY MODEL EQUATIONS NRX/EST AND XE ENGINE SIMULATOR: NUCLEAR INSTRUMENTATION. Mackey, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1965. 37p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

Part of the test site facility in Nevada is a simulator of the equipment being tested, excluding the control systems, which is used to functionally checkout certain parts of the equipment being tested, such as the power and temperature control loops, and for operator training. The models of the nuclear subsystem are of a complexity and accuracy compatible with the needs of the simulator. The heat exchanger and flow dynamics models are considered to be power range models adequate for use with the various control systems installed at Test Cell "A". Preliminary mathematical models are presented for the NRX/EST and XE, heat exchanger, flow dynamics, neutron kinetics, control drum actuators, and some of the instrumentation required to measure system variables for inputs to the control systems. The heat exchanger and flow models represent the heat balance and flow dynamics from the reflector inlet to the core exit. Provisions are made in the flow dynamics to account for the hot and cold (or diluent) bleeds required to simulate the gas flow to the engine turbine. The intent of these models is to represent the static and dynamic characteristics of the nuclear subsystem portion of an overall engine system with an accuracy acceptable for the engine simulation installation at either Test Cell A or at ETS-1. (auth)

16421 (WANL-TME-1113) NRX-A3 REACTIVITY AND SHIMMING REPORT. Hill, D. J.; Nelligan, M. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1965. 95p. Dep. NTIS $7.75.

Declassified 10 Sep 1973.

The reactivity of NRX-A3 was established relative to that measured for the NRX-A2 reactor by a detailed inventory of the physical differences between the two reactors. After careful consideration was given to chemical analysis, data system changes, and the results of the Fuel Reactivity Check (FRC) experiment performed in the PAX-A reactor, it was decided to base the fuel inventory directly on the data packages. The reactivity difference between the two reactors was calculated by applying reactivity coefficients to the mass differences, and by performing transport calculations to determine the reactivity effect of the privy roof mounted shield on the NRX-A3. At the time the NRX-A3 was shimmed, it was found that the NRX-A3, with a shim array equal in worth to the NRX-A2 shim content, was 0.58 ± 0.53 more reactive than the NRX-A2 with the control drums in both reactors at the cold critical drum angle of 97 degrees of the NRX-A2. The critical position for NRX-A3 was predicted to be 90 degrees. Due to the schedule, this calculation had to be made on an estimate of the final fuel inventory. Later the remaining fuel data packages were included in the inventory and the worth of the privy roof mounted shield was revised downward following a mockup experiment in the PAX reactor. These changes bring the predicted drum angle to 91.3 degrees. (auth)

16422 (WANL-TME-1131) NOTES OF MONTHLY COMPONENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON MARCH 4, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1965. 12p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The tests were mostly related to tie rods, support springs, core insulation, support blocks, pyrofoil wrappers, etc. However, static and fatigue testing of fuel elements and clusters continued. (LTN)

16423 (WANL-TME-1138) PRELIMINARY INTERELEMENT CORROSION STUDY. Steffen, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1965. 54p. Dep. NTIS $5.75.

Declassified 10 Sep 1973.

One of the factors which determines the power level and operating time of the NRX-A reactor core is the extent of the corrosion on the outside surfaces of the fueled and unfueled elements exposed to the interelement flow of hydrogen. To understand this problem, data must be obtained on the corrosion in small interstices so that the controlling parameters can be better understood and the rate of corrosion more accurately predicted. A test to study hydrogen corrosion in the interstices between unfueled graphite fuel elements is described. A test rig was designed to test a solid NRX-A fuel element in contact with other fuel elements on all sides mounted in a manner to allow flow along two opposite flats of the element and no flow along the four remaining flats. The gap thickness is one of the variables. The test was run at 3500°R for 30 minutes, with hydrogen flowing through the 0.002-inch gap at the rate of 0.000381 lb/sec. Post-mortem examination showed local areas of corrosion toward the exit end of the flow channels. Weight changes, although small, showed that the larger portion of the weight was lost on component hardware rather than on the test specimen itself. Evidence of hydrogen passing through the porous graphite parts is also present. The data show excellent temperature, flow and pressure control, and uniform temperature distributions. (auth)

16424 (WANL-TME-1141) PROGRESS REPORT ON HIGH TEMPERATURE TESTS OF CORE COMPONENTS. Watjen, E. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1965. 26p. Dep. NTIS $4.50.

Declassified 10 Sep 1973.

High temperature testing has been conducted on fuel elements, new cluster designs and other core components. Early tests of short cluster assemblies have shown that fuel element coatings tend to flake or blister on the external flats. To understand and solve this problem, further tests have been made to eliminate some of the variables. While all of the variables have not been eliminated, preliminary results indicate that loss of coating is more noticeable at temperatures above 3000°R. Support blocks have been tested to ultimate mechanical loads at temperatures up to 5000°R. The results show that failure loads are generally higher than for room temperature tests but have a greater scatter. The lowest failure load recorded was 5600 lb at a temperature of 3460°R. For comparison, room temperature tests averaged an ultimate mechanical load of 4000 lb. All of the support blocks tested failed at loads well in excess of the design loadings. (auth)

16425 (WANL-TME-1164) PROTECTIVE COATINGS FOR THERMOCOUPLE SHEATHS. Levine, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 May 1965. 26p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

A protective coating on refractory metal sheaths is required for reactor thermocouples intended to operate in a hydrogen-carbon environment at 5000°R for one hour. Both tungsten vapor-deposited coatings and surface carburization of the sheath appear to be satisfactory means of preventing hydriding and growth of tantalum. For the use of vapor-deposited tungsten, Vendor B is capable of supplying a high-quality product superior to that of Vendor A. The described tests on molybdenum and tungsten-26% rhenium specimens will determine the capability of vapor-deposited tungsten coatings to prevent metal-carbon eutectic reactions from occurring at the maximum temperatures of reactor operation. (auth)

16426 (WANL-TME-1166) NOTES OF MONTHLY COMPONENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON MAY 6, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1965. 10p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

Reactor component testing results are reported on: fuel elements (mechanical and corrosion tests), support blocks (mechanical and thermal tests), graphite inner reflectors (pressure testing), beryllium outer reflector tests, friction measurements after contact exposure to high temperature and pressure, mechanical properties of pyrolytic foil wrapper material, core diameter versus bundling pressure, etc. (LTN)

16427 (WANL-TME-1167) EVALUATION OF FUEL PARTICLES. Feild, A. L. Jr.; Brizes, W. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 May 1965. 27p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

A considerable number of qualification, production and development batches of pyrolytic carbon-coated fuel particles from two different vendors was evaluated by (1) coating thickness and its variability and (2) thermal migration at 2300°C for 4 hours. Some batches were evaluated at higher temperatures 2500°C for ½ hour. One vendor had good coating thickness uniformity and another had wide variations from batch to batch—some failing the specification minimum thickness. The reasons for some of the variations were recognized and later batches showed a great improvement. While most batches met the less than 3 percent migration at the lower temperature, the migration was much greater and more variable from batch to batch at the higher temperature (from 1 to essentially 100 percent). The reason for the wide variation was not identified. Some coating development experiments are discussed. Radiographic and electron microprobe methods of evaluation are treated briefly. (LTN)

16428 (WANL-TME-1174) ANALYSIS OF THE RE-ENTRY BEHAVIOR OF A NERVA VEHICLE. Trammell, M. R.; Grob, L. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1965. 119p. Dep. NTIS $9.00.

Declassified 11 Sep 1973.

The details of a preliminary structural and aerodynamic analysis of the NERVA reactor re-entry vehicle under certain re-entry conditions are presented. Two proposed lunar transfer missions for the NERVA engine are considered; one involves orbital startup of the nuclear stage and the other requires a suborbital nuclear start. Failures have been assumed to occur at selected intervals during the nuclear stage operating period of each mission and trajectories of the re-entering reactor vehicle computed for each case. The aerodynamic loads to which the reactor re-entry vehicle would be subjected have been determined for representative trajectories. It has been found, through a preliminary stress analysis, that the aerodynamic loading alone (neglecting aerodynamic heating) is insufficient to cause disassembly of a cold, undamaged reactor vehicle. The temperature histories of various components of the reactor have been generated following failure after each of several different operating periods. Loss of coolant was the failure assumed in all cases. An assessment of the effects of post-operational heat on the structural integrity of the reactor has been made. It was found that the reactor would completely disassemble within about three hours of failure due to tumbling forces acting on a structure weakened by post-operational heat. This result indicates that, for the present NRX-A design reactor, re-entry of an intact reactor vehicle following orbital failure is impossible. Disassembly during re-entry from suborbit start followed by failure is not certain, though it appears that at least some fuel elements will be lost from the vehicle at high altitudes, thus spreading the radioactive debris over a relatively large area. (auth)

16429 (WANL-TME-1180) RADIATION TEST OF NRX O-RING SEALS (WANL TEST 15/W401). Zorn, J. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1965. 31p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

Eight silicone rubber O-rings were irradiated in the Ground Test Reactor/Ft. Worth (GTR Cycle No. 16) to evaluate their structural integrity under an environment approaching that expected during the NRX-A3 run. All eight specimens were exposed only to a hydrogen environment during irradiation, with four specimens being maintained at cryogenic temperatures while four were at ambient temperature conditions. All eight irradiated O-rings were removed from the test fixture without damage. A high degree of embrittlement and a small increase in density occurred as a result of radiation-induced crosslinking; this crosslinking had caused the specimens to take a permanent set into the shape which they were compressed during irradiation. Small lips or extrusions into clearance areas were observed after irradiation indicating that the rings would still act as adequate seals. Dimensional analysis showed that the specimens retained the dimensions of adjacent components without shrinkage. The nature of the silicone rubber was completely altered by the irradiation and all specimens fractured in a brittle manner independent of the environmental temperature during irradiation. However, results of tests for Young's Modulus, compressive strength, tensile strength, and spring (deflection) rate, as well as several qualitative observations, indicated that the specimens have relatively good strength properties and a fair degree of elastic toughness or resiliency. Consequently, it is believed that they will sustain the maximum compressive load (25 lb) anticipated during service as well as a small amount of shock loading. Based on the results of this experiment it is believed that the silicone O-rings will exhibit satisfactory performance during NRX-A3 service. (auth)

16430 (WANL-TME-1189) BETA-BACKSCATTER THICKNESS MEASUREMENTS OF DEPOSITED NIOBIUM CARBIDE ON FLAT GRAPHITE SURFACES. Steele, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jun 1965. 64p. Dep. NTIS $6.25.

Declassified 11 Sep 1973.

A low cost, portable beta-backscattering thickness gage ("Micro-Derm") was purchased from Unit Process Assemblies, Inc., to investigate thickness measurements of flat niobium carbide coatings over a graphite substrate. Original coating thickness considerations included a range of 1-5 mils. Subsequent considerations have included relatively thin coatings up to 0.0005 inch for both fueled and non-fueled element exterior surfaces. Preliminary performance data is described in the thickness range of 1 to 5 mil niobium carbide. Within the scope of this work, these data indicate that Micro-Derm beta-backscattering measurements can be achieved within ten percent of the results obtained by direct metallographic measurements. Subsequent to the initial investigation, the basic electronic unit was modified to increase the reliability of the coating thickness determinations. (auth)

16431 (WANL-TME-1195) NRX-A3 DOSIMETRY MEASUREMENTS (PARTS I AND II). Brooks, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1965. 72p. Dep. NTIS $6.75.

Declassified 11 Sep 1973.

The results of gamma and neutron dosimetry measurements performed during the NRX-A3 power tests are reported. The major purpose of the measurements was to provide better definition of the radiation environment about the reactor. The experimental methods are described. Gamma exposure measurements utilized thermoluminescent detectors; the neutron flux measurements utilized copper, cobalt, gold, and nickel dosimeters. (auth)

16432 (WANL-TME-1206) NERVA CORE SUBASSEMBLY FLIGHT SAFETY FAILURE MODE ANALYSIS. Contreras, W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1965. 98p. Dep. NTIS $8.00.

Declassified 11 Sep 1973.

The results of a flight-type failure mode analysis performed on a core sub-assembly of a NERVA reactor are reported. The objectives were to examine the reliability of the core sub-assembly from the standpoint of flight safety and select those components most prone to failure. Eleven components were selected and subjected to a failure mode analysis. Effects due to corrosion and possible radiation damage incurred during sustained full-power operation have been taken into account as well as the effects due to transient and steady-state operation. The core sub-assembly components analyzed are listed and the results are given briefly (filler strip, insulating tile, cluster plate, centering and jet orifice bushings, insulating and countersunk sleeves, support blocks, insulating cups, tie rods, split bushings, unfueled elements, fueled elements). It was concluded that the probability of survival of the NRX-A4 core sub-assembly during sustained full-power operation is quite high. However, uncertainties arise due to lack of information on the effects of irradiation on core sub-assembly components. Furthermore, experimental evidence obtained during the NRX-A2 test indicates that corrosion will have a deleterious effect upon a number of these components. These effects will undoubtedly lower the probability of survival of the core sub-assembly. (auth)

16433 (WANL-TME-1207) PLUGGED CORE FLOW TEST REPORT. Phase I Tests. Seal Perturbations. Salvador, L. A.; Schulman, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. 103p. Dep. NTIS $8.25.

Declassified 10 Sep 1973.

The Seal Perturbation Series of experiments performed on the ND 20701 reactor (Plugged Core) conclusively demonstrated the overall stability of the NRX-A1 design configuration within the envelope of conditions explored. These conditions were ambient temperature hydrogen flow at core inlet pressures ranging from 100 to 700 psia, core pressure drops from 0 to 130 psi, and varying degrees of seal perturbation from a normal condition to venting all 16 effective seals. Core and seal pressure data, core isobar plots, and mechanical data are presented for both perturbed and unperturbed operating conditions. The isobar plots, based on conformal mapping techniques, indicate the possibility of core radial inflow from the seal region along the first ⅘ of the core periphery. Radial outflow along the last ⅕ of the core periphery is indicated. This is inferred from the existence of a high pressure area at the aft end of the core and a "trough" like depression extending from the aft end peripheral corner of the core, as deep as the 13.5-inch radius, and as high as the 30-inch core station. In addition, core pressure profiles indicated a positive, stable, bundling force throughout the core with minor exceptions at the aft end and core centerline, for both perturbed and unperturbed operating conditions. Mechanical data indicated that all observed stresses were within design limitations. (auth)

16434 (WANL-TME-1208) NON-NUCLEAR QUALIFICATION TEST ON STATION 45 THERMOCOUPLE DESIGN FOR NRX-A4 IN-CORE APPLICATION. Malinchak, R. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 Jul 1965. 37p. Dep. NTIS $5.00.

Declassified 11 Sep 1973.

Three tests simulating reactor conditions were conducted in the WANL Hydrogen Corrosion Facility to determine if Westinghouse thermocouple design 978D272HO1 was qualified for NRX-A4 Station 45 core temperature measurement. On the basis of these tests, this thermocouple design has been determined to be unsuitable for in-core applications. Five of the six tungsten-coated tantalum sheaths failed due to hydriding of the tantalum sheath in such a manner that the central element was damaged. This damage was such that, in a reactor application of the thermocouple, the resultant central element damage could cause corrosion damage to the reactor. It is concluded that a thin tungsten coating is an unreliable protective system for tantalum against hydrogen. The measurement accuracy of these .015" diameter thermoelements is much improved over the earlier designs using .005" diameter thermoelements since the larger diameter conductors aid in overcoming the electrical shunting effect of BeO insulators at high temperature. It is recommended that further testing be done on this thermocouple design in order to obtain more samples for electrical performance evaluation. The present results prove that reasonable accuracy of measurement can be achieved if a suitable sheathing system can be developed. (auth)

16435 (WANL-TME-1213) COMBINED STATIC AND ALTERNATING LOAD TESTS OF NRX-A TYPE TIE RODS. Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1965. 33p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

Room temperature S-N curves were obtained for both Inconel 718 and X750 tie rods under several mean stress levels. Pure alternating stress tests were run on the button and thread end of the tie rod. Static tensile tests of the two types of tie rods have been run on various batches and the results of these quality control type tests are summarized. The effect of prior high cyclic strain on the tie rod fatigue life has been investigated. The effect of spot-welded strain gages is discussed. The results of the fatigue tests on Inconel X750 tie rods indicated that the stress-cycle data compared favorably with bar stock data of the manufacturer, whereas, the Inconel 718 tie rod results were about 20% below the bar stock data as given in the Westinghouse Materials Handbook. Under combined loading conditions the Inconel 718 tie rods exhibited a higher fatigue resistance due to the much higher yield strength. They were approximately 25% higher, at the mean load of 530 lb, than the Inconel 750 tie rods. The Inconel 718 tie rod results, when plotted on a combined loading Constant Life Diagram (Goodman and Soderberg) showed that the data fell considerably below the usual straight line relationships. These Constant Life Diagrams are presented, showing the combined stress relationships for tie rods made of the two materials. It is shown that spot welding of strain gages on X750 tie rods causes a strength reduction factor of about 2.0 at a 2×10^6 cycle life. (auth)

16436 (WANL-TME-1221) NRX-A6 DESIGN MODIFICATIONS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1965. 139p. Dep. NTIS $10.00.

Declassified 12 Sep 1973.

The status of the modified NRX-A6 reactor design and analysis effort at the time of the review meeting held at the Astronuclear Laboratory on June 29, 1965 is presented. The major objectives of the NRX-A6 design modifications have been to: Provide a basic reactor structure which could be scaled both in power density and size; provide the capability to permit substantial fuel development in the small reactor size; increase component design margins to improve reliability so that the technology developed could be used in prototype engine development; and obtain the design flexibility to incorporate any of the core periphery and lateral support system configurations which component and previous NRX and PHOEBUS reactor tests may indicate to be solutions to the core corrosion problems. A design goal has been the ability to incorporate a hot periphery as well as any of the cooled periphery configurations considered. The characteristics of these peripheries are described. These design studies have been limited to the more important design objectives and an effort has been made to retain flexibility in unresolved areas where further effort is continuing, e.g., core corrosion problems. (auth)

16437 (WANL-TME-1224) COUPLED NOFLOW-FIPDIF COMPUTER PROGRAM. Cleary, J. D.; McCune, W. C.; Trammell, M. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1965. 110p. Dep. NTIS $8.50.

Declassified 12 Sep 1973.

The NOFLOW-FIPDIF computer program has been written to perform the following two related functions: Determination of the temperatures attained by reactor materials following a loss of coolant accident; and evaluation of the fission product inventory which would exist at any time (following loss of coolant). To accomplish these objectives, heat transfer calculations are performed for each of sixteen sections of the core, tie rods, filler strips, reflectors, and the pressure vessel. Other components are divided into an appropriate number of sections. The program has been designed to calculate the fission product inventory due to eighty decay chains in each core section. Thus, the effects of axial power and temperature variation may be reflected in the decay heat source calculations. The program has been used to simulate accidents involving loss of coolant during the initial firing of a nuclear reactor and during a re-start run. (auth)

16438 (WANL-TME-1225) STRESS ANALYSIS: NRX-A4. Eggers, A. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 27p. Dep. NTIS $4.50.

Declassified 12 Sep 1973.

The stress analyses performed to determine if the NRX-A4 is structurally capable of withstanding the conditions which will be imposed on it during the forthcoming NRX-EST test are summarized. Since the NRX-A4 differs only slightly from the earlier NRX-A2 and NRX-A3 reactors which survived power tests and restarts without serious damage, the basic NRX-A4 design has been demonstrated to be adequate. Local cracking of some support blocks will occur at the outer corners of the support washer seats. More corrosion should be expected in this area than was observed in the NRX-A3. The membrane stress in the control drum housing weld should never exceed the yield strength. The control drum rubbing problem encountered in NRX-A1 and A3 should not recur in NRX-A4 provided the reflector temperature is below 540°R at the initiation of flow. Recent tests indicate that irradiation tends to make the already brittle beryllium more brittle. If this data is applicable, it indicates that some sector web cracking could occur. No serious consequences are anticipated, even if such damage should occur. The substitution of solid, unfueled, partial elements for the peripheral partial elements results in higher fuel element tensile stresses. The probability of partial element survival will be increased by the reduction in corrosion rate. (auth)

16439 (WANL-TME-1258) COMPONENT TEST FFL-17: PLUGGED CORE TRACER GAS TESTS. Salvador, L. A.; Schulman, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. 219p. Dep. NTIS $14.00.

Declassified 12 Sep 1973.

A gas tracer technique was developed for the study of leakage flow paths in NRX-A reactors. Parameters related to the technique were optimized and the procedures were employed in fifty-eight flow tests to study leakage flow lines. Methane was injected into the reactor through probes in and above the core and in the seal chambers. Samples taken through probes downstream of the injector, when analyzed, gave a set of concentration profiles throughout the core. The locus of peak concentrations on these profiles represented the path of the tracer gas stream as it flowed through the core. Pressure data was also obtained for probes located on five axial, four radial, and three azimuthal locations. Pressure contours and flowlines inferred from the data are in good agreement and, in general, are consistent with an assumed potential flow model. Flow in the reactor is axial in the center cylindrical portion of the core and inward from the periphery on the outer radii over the top 40-inches of the core. Below this elevation flows are directed outward to the periphery from points as far into the core as the centerline. Mechanisms for the observed flow behavior are advanced and a model is suggested which combines the effect of flow into the top and sides of a cylinder, a point source near the bottom of a cylinder, and flow from peripheral pores near the bottom. (auth)

16440 (WANL-TME-1346) TRANSACTIONS OF THE NON DESTRUCTIVE TESTING SYMPOSIUM HELD NOVEMBER 16–17, 1965 AT WESTINGHOUSE ASTRONUCLEAR LABORATORY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1966. 250p. Dep. NTIS $15.50.

Declassified 30 Aug 1973.

Nondestructive methods of testing NERVA fuel elements were reviewed: Backscattering techniques, eddy current testing, gamma seams, replica techniques, etc. Measurement instrumentation is discussed in several papers. Finally, the uses of the measurements are discussed. (LTN)

16441 (WANL-TME-1354) NRX-A CANDIDATE STRAIN GAGES EXPERIMENT NO. 23/W408 IRRADIATED AT PLUM BROOK REACTOR FACILITY: PBRF CYCLE 40. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1966. 49p. Dep. NTIS $5.50.

Experimental data from an irradiation of strain gages in the Plum Brook reactor are presented. The purpose was to obtain operational data on NRX-A candidate strain gages in a high dose rate radiation environment and to provide additional data to establish the cause of the extreme zero shift encountered in strain gage test 23/W406 previously irradiated in the Plum Brook reactor. The test assembly was designed and fabricated in the WANL Instrumentation Laboratory, laboratory tested and then water-loop tested which simulated all HT-1 operating conditions except the nuclear environment. The assembly was installed in the Plum Brook Reactor which was operated at 60 MW for 28.3 hours. (auth)

16442 (WANL-TME-1366) WELDABLE AND BONDABLE STRAIN GAGES IRRADIATED AT PLUM BROOK REACTOR FACILITY (EXPERIMENT 23/W408 PBRF CYCLE 40) (NE 2460). Pappas, T. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Jan 1966. 34p. Dep. NTIS $4.75.

The evaluation of strain gages in a nuclear radiation environment is reported. Strain gages are to be utilized in the NERVA reactor to diagnose strain in structural members. Test information and test evaluation is presented for four pairs of Budd "C" series gages bonded with "H" ceramic cement and six active-dummy Microdot weldable gages which were irradiated at the Plum Brook Reactor Facility during November 1965 (PBRF test 23/W408). Both types of strain gage can survive the radiation levels experienced in the PBRF Reactor. However, a detailed analysis of the strain gage performance has resulted in the following conclusions: (a) Budd series "C" foil gages bonded with "H" ceramic cement can be used for NRX application, such as the tie rods, lateral support springs, and titanium core band with an estimated overall accuracy of ± 100 microinches per inch for an one hour, full power NRX test duration. (b) Microdot weldable active-dummy gages can be used for NRX application, such as the tie rods, lateral support springs and titanium core band with an estimated overall accuracy of ±500 microinches per inch for a one hour, full power NRX test duration. However, to achieve this accuracy a zero shift correction must be utilized. (auth)

16443 (WANL-TME-1381) UPGRADING OF THE SINGLE ELEMENT HYDROGEN CORROSION TEST. Scherer, P. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1966. 34p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

A hardware development program was undertaken to upgrade furnace performance for the single element hydrogen corrosion test. Hot and cold end chucks were designed to eliminate electrical arcing failures of the fuel element under test. Molybdenum radiant heat shields were installed to reduce heat losses from the test sample thereby decreasing the element radial temperature gradient. Improvements in furnace instrumentation have facilitated the collection of more complete test data from which evaluation of single element test conditions can be made. Although the single element hydrogen corrosion test does not duplicate conditions found in the NERVA reactor, the following changes were made to improve the degree of reactor simulation: A twenty mil hydrogen flow passage cut into the hot chuck approximates reactor nozzle end corrosion. An inlet gas seal prevents mixing of the helium and hydrogen atmospheres and allows simulation of pinholing pressure conditions. The molybdenum shields decrease the radial temperature gradient in the test sample by 250°R. (auth)

16444 (WANL-TME-1424) NERVA REACTOR MODEL FOR SYSTEMS ANALYSIS. Blake, P. J.; Lynch, R. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1966. 18p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The analytic model of the NERVA reactor used in recent analog and digital computer studies of the NERVA engine system is documented. It is based on NRX-A5 and detailed reactor design data. (LTN)

16445 (WANL-TME-1462) HHT-7 FILLER STRIP CORROSION TEST MODEL: TEST REPORT NO. 3, HOT BUFFER TYPE PERIPHERAL CORE DESIGN. Cherish, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1966. 210p. Dep. NTIS $13.50.

Declassified 12 Sep 1973.

Post test examination of the graphite material from reactors tested to date has revealed that the rate of hydrogen corrosion of the graphite at high temperatures is still one of the primary factors limiting the life of current NERVA reactor designs. In order to increase the life of current reactors, it is necessary to minimize the effects of hydrogen-graphite corrosion in critical problem areas, e.g., fuel element bore corrosion, support block corrosion, and core peripheral corrosion. In an effort to study one phase of the corrosion problem in the core periphery, a filler strip corrosion test program utilizing a small diameter core model was initiated. This program is intended to provide experimental information to qualitatively evaluate, by comparison, core peripheral corrosion, its behavior, and its effects on peripheral type components. Three filler strip corrosion test models have been tested. Through redesigns incorporating advanced development techniques, each model test has demonstrated an increased improvement in its ability to reproduce representative reactor type corrosion behavior. The results are useful in evaluating current and proposed core peripheral design configurations. The results of a test conducted with a proposed peripheral core design, i.e., The Hot Buffer Periphery, are summarized. The test apparatus and environmental conditions are described and the results discussed. General information on the corrosion behavior in a small diameter component core model utilizing a hot buffer type peripheral core design is given. (auth)

16446 (WANL-TME-1473) COMPARISON OF NRX/EST TRANSIENT DATA WITH POST-TEST COMMON ANALOG MODEL RESULTS. Goldberg, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1966. 60p. Dep. NTIS $6.00.

Declassified 12 Sep 1973.

NRX/EST transient test data for the nuclear subsystem have been compared with post-test analog model results. The specific transient tests selected for these comparisons between analytical and test results were specified reactor startups and shutdowns. From these comparisons it was concluded that the accuracy of predictions of the analog computer nuclear subsystem model was generally good. It was noted however that: (1) the portion of the dynamic model that computes the average tie rod exit gas temperature needs some improvement because of failure adequately to simulate decay heat; (2) it is necessary to include in the mathematical model of the reflector inlet plenum the effects of fluid compressibility at the critical point in order to predict fluid system oscillations observed during early portions of the start-up transient; (3) if accurate predictions of system dynamics are to be obtained in cases where significant core corrosion has occurred, then some allowance for this must be included in the analog model; and (4) the calculation of core pressure drop is quite good at or near the design point but needs improvement at low power and low flow. (auth)

16447 (WANL-TME-1479) EVALUATION OF EXTRUDED-TO-SIZE ELEMENTS. Leasure, R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1966. 8p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

One of the fuel element production processes being evaluated in the NRX-A5 development program is the process of extruding the bores of elements to size followed by coating in the leached or non-leached condition. The corrosion properties of these extruded to size (ETS) elements were evaluated through a series of hydrogen corrosion tests. Additional evaluations were made by metallographic examinations, electrical resistance, and accelerated hydrolysis studies. The limited number of corrosion tests performed on ETS leached and non-leached elements show that these elements have poorer corrosion behavior than do standard reamed elements. The major defect resulting from extruding elements to size that can be seen in the microstructure of these elements is the presence of large porous areas which extend into the channels. There are indications that some of these areas may break away during hydrogen testing allowing large areas of graphite to be exposed. (auth)

16448 (WANL-TME-1528) HEATER ELEMENT DESIGN STUDY FOR MULTIPLE CLUSTER THERMAL TEST. Ferris, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Sep 1966. 38p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

A design approach is indicated using a central hollow hairpin-type electrical resistance heater element fabricated of graphite to keep the maximum temperature of the graphite in the heater element below 6600°R while accomplishing the heat flux required by Test FFL l.g. When the heater element is as small as 2⅛ inches in diameter, a minimum wall thickness of .12 inches is required. It is demonstrated that 6600°R is a reasonable temperature limit to design for without incurring graphite sublimation under furnace pressures of 700 psi. The hairpin heater element is easily fabricated, inherently allows both electrical connections to be at the top cold end and allows free expansion without restraint under changing temperatures. The 2⅛ inch diameter heater element would have a design-point current and voltage requirement of 1060 amperes and 171 volts. If the heater element diameter is allowed to be larger, the minimum wall thickness can reasonably

be quadrupled and the current and voltage schedule can be varied over a wide range: volts down to 70 and amperes up to 2500, all in combinations of producing an input of 181.5 kw. The use of thin hollow cylinders avoids high internal material temperatures when the sublimation temperature of graphite is approached. (auth)

16449 (WANL-TME-1568) NRX A6 STATUS AND FUEL DEVELOPMENT REVIEW HELD AT WANL, JANUARY 25, 1967. Morris, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1967. 101p. Dep. NTIS $8.25.
Declassified 10 Sep 1973.

16450 (WANL-TME-1571) SPACE ENVIRONMENTAL EFFECTS ON NERVA REACTORS. McAndrew, J. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1967. 38p. Dep. NTIS $5.00.
From a survey of historical experience with spacecraft and of current estimates of space conditions, it is concluded that (1) no insurmountable difficulties will arise in space operation of the NERVA reactors, (2) application of all available knowledge concerning space environmental effects must be one of the inputs to the reactor design in every detail to ensure against malfunctions that could have serious consequences, and (3) there are certain areas of uncertainty that should be explored further to improve confidence that no potential problems have been overlooked. To implement conclusion (2), it is recommended that a close surveillance be supported and maintained over the entire field of space environmental effects on materials, and that personnel engaged in mechanical design, reactor analysis, program planning, materials selection, component testing, product assurance, and other related activities be made aware of the need to consider space effects and be kept informed of potential problems as they are foreseen or are eliminated. To implement conclusion (3), it is recommended that in addition to the experimental work outlined, a strong effort be made to develop analytical programs that will predict accurately what the pressures, gas compositions, and component temperatures will be in various regions of the reactor at different times during the course of missions that might realistically be anticipated. It is foreseen that specific experiments on the outgassing rates of various materials under a variety of conditions will be required to supply numerical values for input to such calculations. (auth)

16451 (WANL-TME-1575) NRX-A5 POST OPERATIVE DATA ANALYSIS. Stancampiano, P. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1967. 133p. Dep. NTIS $9.75.
Declassified 10 Sep 1973.
The structural performance of the NRX-A5 reactor has been evaluated. Transducers monitored the core/inner reflector radial gap changes, tie rod loads, core axial displacements, control drum torques, and accelerations of the core support plate, control drums, and pressure vessel. Reactor pressures and temperatures were also measured. Data reduction systems were developed for the computerized mechanical analysis of data from these transducers (MAD codes). These codes showed that the measured data agreed well with calculated estimates indicating that the analytical models of the reactor are good and the structural performance of NRX-A5 was, generally, as expected. Except for short bursts of pressure vessel forward flange vibration, there were essentially no significant vibrations of the reactor components. Damage occurred in the hot buffer filler strip experiment due to thermal stresses developed during the shutdowns. The cracks in the outer perimeter walls of the peripheral support blocks were caused by inflow (leakage) cooling and transient cooling in the block material beneath the unfueled partial elements. Most of the fuel element breakage was due to excessive corrosion; however, inflow (leakage), "oversize" (due to coating) and end-of-life-peaking, radial temperature profiles caused much of the non-corrosive element damage in the periphery. The damage to the 5F4/5F5 clusters was due to fuel element orifice blockage (by hot buffer filler strip debris) and subsequent overheating. The slight aft end liner tube flaring was due to differential thermal expansion of the cluster components after scram. (auth)

16452 (WANL-TME-1584) HIGH TEMPERATURE THERMOCOUPLE QUALIFICATION AND DEVELOPMENT. Interim Progress Report, July 1, 1966–December 31, 1966. Zellner, G. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1967. 169p. Dep. NTIS $11.51.
Declassified 31 Aug 1973.
In NERVA reactor and engine tests, the measurement of temperature and temperature distribution within the reactor core and the exhaust plenum is necessary for both reactor control and engineering analyses. The predictions of reactor efficiency, power limitations, reactivity, and coolant distribution are verified by these measurements. The development and qualification testing of reactor core thermocouples for NERVA applications is reported, with complete thermocouple descriptions, test objectives, performance curves, post test analyses including photographs and photomicrographs, and discussion of the test results. (auth)

16453 (WANL-TME-1600) NRX-A7 FUEL DEVELOPMENT PROGRAM. Boltax, A.; Vogel, C. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 May 1967. 26p. Dep. NTIS $4.50.
Declassified 10 Sep 1973.
A fuel development program for the NRX-A7 reactor is defined. Due to the greater power and flow rate required, the potential for mid-band and hot-end fuel element corrosion is greater, so significant improvements in corrosion resistance will be required. (LTN)

16454 (WANL-TME-1639) STUDY OF THE CORROSION RESISTANCE OF THE "GRAFOIL" WRAPPER SYSTEM. Steffen, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1967. 42p. Dep. NTIS $5.25.
Declassified 12 Sep 1973.
A test program designed to study the corrosion resistance of thermalized and non thermalized "Grafoil" in configurations simulating the NRX-A6 reactor core periphery geometry has been initiated. The effects of flow rate, thermalization, and material temperature were investigated. Tests were conducted at a pressure level of 350 psig for 30 minutes with material temperatures ranging from 3500 to 3700°R and hydrogen flow rates ranging from 4.27×10^{-5} to 8.58×10^{-5} lb/sec. (auth)

16455 (WANL-TME-1641) NRX-A6 TEST PARAMETER LIMITS JUSTIFICATION. Shufelt, C. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1967. 13p. Dep. NTIS $4.00.
Declassified 12 Sep 1973.
The justifications for the selection of the Test Parameter Limits are presented and the supporting references listed. The Emergency Shutdown Chain Inputs and Cooldown Limits are similarly treated. The information presented will be of use to the engineering groups in the planning, analysis and conduction of NRX-A6 tests in such a way as to minimize reactor problems and hazards to the people involved. (auth)

16456 (WANL-TME-1644) PRELIMINARY INVESTIGATION OF REACTOR EMERGENCY COOLING REQUIREMENTS FOR NERVA. Trammell, M. R.; Pierce, B. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Aug 1967. 101p. Dep. NTIS $8.25.
Declassified 12 Sep 1973.
An emergency auxiliary cooling system can be devised which appears to fulfill the required purposes of such a system; that is, for many potential accidents which can lead to rapid loss of the main coolant supply to the reactor, it is possible to preserve sufficient structural integrity within the reactor so that safe disposal of the radioactive core may be insured. Three possible conceptual systems have been examined in a preliminary fashion and found to accomplish this aim with varying degrees of success. Emergency cooldowns which make use of the normal coolant flow paths require: That the normal coolant supply paths remain intact and operational after the accident; that the Dewar containing the emergency fluid supply (~3050 lb of LH_2) be pressurized to at least 350 psi; and that additional hardware in the form of feed lines and check valves be incorporated into the system to provide a path for supply of run tank fluid directly to the nuclear subsystem under run tank pressure. The principal advantage of this type of emergency cooling is that it appears to be capable of preserving the reactor in a restartable condition if the accident which initiates emergency flow is fixable. Emergency cooling through the tie tube flow system requires that at least 3000 lb of emergency fluid be pressurized to about 450 psi. If used, this cooling should be terminated no longer than 300 seconds after the accident to avoid overcooling and consequent criticality problems. The concept of supplying emergency cooling fluid direct from the run tank to the reactor dome promises to be the most economical, with respect to payload penalty, of the systems examined since no high pressure Dewar is required. It does require the addition of lines, valves, and logic for emergency pulse cooling into the system. Finally, the addition of any EACS to the engine may also require that redundant, or larger, attitude control systems be incorporated into the vehicle control system. (auth)

16457 (WANL-TME-1660) RESULTS OF THE PHASE II-1B (2) NRX-A6 FUEL ASSESSMENT TESTS. Kanter, I. E.; Horton, W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1967. 84p. Dep. NTIS $7.25.
Declassified 12 Sep 1973.

The purpose of the Phase II-1b (2) test series was to develop quantitative information on the effect of power and hydrogen flow rates on fuel element performance in an electrical corrosion test and to relate the test results to the dependence of fuel element corrosion in reactors on reactor power and/or hydrogen flow. A number of conclusions resulted. Briefly stated, of the initially planned variables: 1) the power/flow ratio and power are found to significantly affect the hot end corrosion, and 2) midband variables, which are significant, are exit pressure and its interactions with time, and the interaction of power/flow ratio and time. When the engineering parameters associated with the measured test variables are treated: 1) coating thickness, mass velocity, bore pressure, and stream kinetic energy show significance with respect to corrosion of the midband region along with a temperature effect at the cold end; and 2) hot end corrosion was found to be dependent on the channel wall temperature, helium to hydrogen radial pressure drop, and the stream kinetic energy. The results have been formulated in empirical expressions explicit in local weight loss. Caution should be used when applying the quantitative information to fuel elements made to different specifications or over conditions outside of the range utilized in this study. The use of statistical methods was employed and a reliable estimate of the random error in the tests has been obtained. (auth)

16458 (WANL-TME-1669) NRX-A6 BORE COATING DEVELOPMENT. Phases III-12, III-13A, and III-27. Wilks, P. H.; Bartholomew, D. C.; Hollabaugh, C. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1967. 58p. Dep. NTIS $6.00.

Declassified 12 Sep 1973.

Theoretical considerations and the results of the NRX-A5 reactor tests indicated that thin midband coatings deposited at relatively low temperatures would provide improved midband corrosion protection for NRX-A6. The concepts underlying this process change are described and the results of its implementation are presented. Confirmatory electrical corrosion test results are included. (auth)

16459 (WANL-TME-1677) WESTINGHOUSE ASTRONUCLEAR EXPERIMENTAL FACILITY EXPERIMENTAL PROGRAM (NERVA CONTRACT YEAR 1968). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1967. 29p. Dep. NTIS $4.50.

Declassified 12 Sep 1973.

The nuclear experiments which will be conducted during Contract Year 1968 are described. These experiments include measurements in support of XE-1 and XE-2, the design of the NR-1 shield, nuclear design methods development, and NR-1 critical mockup experiments using the FCX. These measurements have been planned and designed to provide the NERVA Program with experimental data for nuclear design, radiation and shielding analysis, analytical methods development, and the operations at NRDS. The measurements in support of XE-1 and XE-2 include calibration of detectors, power distributions, reactivity worths, individual control drum and drum bank worths, radiation and shielding measurements, as well as fuel reactivity check (FRC) measurements with final design XE-2 fueled elements. (auth)

16460 (WANL-TME-1681) PARAMETRIC ANALYSIS OF NR.1 FLIGHT SHIELD CONFIGURATION. Ricks, L. O.; Stephenson, L. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1967. 95p. Dep. NTIS $7.75.

Declassified 10 Sep 1973.

The effects of the location and geometry of a TiH–B_4C–Al flight shield on the external radiation environment of a 5000 MW NR-1 reactor have been evaluated in terms of nuclear heating at the hydrogen propellant tanks in both single and clustered configurations, inasmuch as tank heating has been the gauge by which shields have been compared in previous studies. Three basic shield locations considered were: Below the core support plate, combined with the core support plate, and above the core support plate. The shield geometry was varied parametrically to include several thicknesses of the central portion of the shield (with radius equal to that of the reactor core) as well as several thicknesses of the peripheral shield region (located above the reflector). This study reconfirms the findings of the NR-1 Nuclear Subsystem Parametric Study that the optimum location for the shield is below the support plate; i.e., between the core and support plate regions. Apparently the advantages of this location far outweigh the disadvantages since the radiation effects and heating rates in the shield are not considered a problem in the light of the present state-of-the-art knowledge concerning these effects on the selected TiH_x–B_4C–Al composite shield material. The uncertainties in shield thickness which presently exist because of undefined shield criteria and uncertainties in shield attenuation can be tolerated without undue weight penalty by providing additional space over some nominal requirements for potential growth of the shield. (auth)

16461 (WANL-TME-1686) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON OCTOBER 3, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 Nov 1967. 80p. Dep. NTIS $7.00.

Declassified 10 Sep 1973.

Tests were conducted in support of NRX-A6, NR-1 and XE-PRIME reactors on fuel elements, graphite component corrosion, orifice calibration, graphite permeability, thermal shock, friction, brazing, and control drum bearing tests. (LTN)

16462 (WANL-TME-1699) FINAL REPORT ON TEST SPECIFICATION III-4A REVERSE COATING. Bartholomew, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Oct 1967. 13p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

Since the NRX-A4 and NRX-A5 reactor tests indicated cracks formed by high deposition temperatures and differences between coating temperatures and reactor temperatures were deterimental to reactor performance, it was deemed advisable to attempt coating at temperatures which resembled reactor temperatures as nearly as possible. For this reason, it was proposed that the direction of gas during coating be reversed and combined with generally lower temperatures to result in a better match of coating temperatures with reactor operating temperatures. Although it was impossible to validate the theory through comparison or corrosion tests, photographic evidence of more adherent coatings with narrower room temperature cracks strongly suggests that the cracks would be narrower at operating temperatures if lower coating temperatures are used. With narrower cracks and better adherence at operating temperatures, an improvement in corrosion behavior should be observed. It is impossible to precisely match the reactor gradient due to furnace limitations. In addition, it would be impossible to deposit niobium carbide at the low temperatures observed near the entrance end of the reactor. For these reasons, it was decided to match the mid-band temperatures only. (auth)

16463 (WANL-TME-1700) NRX-A6 RADIATION ANALYSIS MODEL. Capo, M. A.; Nassano, R.; Stephenson, L. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Sep 1967. 49p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

Basic geometrical, material, and radiation source data are presented to serve as a radiation analysis model for the NRX-A6 reactor in the ground test configuration. These data provide the standard representation of the NRX-A6 system for over-all radiation analyses of the system, including calculation of radiation environment and heating rates both internal and external to the reactor. (auth)

16464 (WANL-TME-1707) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON OCTOBER 31, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 55p. Dep. NTIS $5.75.

Declassified 10 Sep 1973.

Tests in support of NRX-A6 and XE-PRIME reactors involved fuel element development, filler strip corrosion, orifice calibration, supports, thermal shock (graphite and beryllium), wrapper leakage and other miscellaneous tests. (LTN)

16465 (WANL-TME-1718) FINAL REPORT ON TEST SPECIFICATION III-11A EXTERNAL SURFACE TREATMENT. Bartholomew, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Dec 1967. 47p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

An unsuccessful attempt was made to develop an O. D. coating process which would produce acceptable NRX-A6 fuel elements. It was noticed that the bore performance of the sequential runs was superior to that of NRX-A5 type run. However, the poor end performance of elements in these runs negated any potential benefits that may have been derived from the reverse sequential process. A concerted effort was subsequently directed at resolution of the coarse crystalline deposit problem. The solution to the crystalline problem, combined with the work in this specification, led to the development of a superior fuel element. (auth)

16466 (WANL-TME-1757) XE-2 FUEL REACTIVITY CHECK EXPERIMENT. Freidhof, W. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1968. 28p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

A series of measurements have been carried out on the PAX-E4 reactor, wherein the reactivity differences between NRX-A5 type

fuel and XE-2 type fuel were measured. Both fuel from WNCO and the Oak Ridge Y-12 facility were employed in the experiment. From the available data, it appears that about one-half of the NRX-A5 (WNCO) elements were recoated at some time, possibly to mockup the heavier NRX-A6 Build 1 coating. The large reactivity changes are attributed to this recoating. (auth)

16467 (WANL-TME-1765) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON FEBRUARY 29, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Mar 1968. 75p. Dep. NTIS $6.75.

Declassified 11 Sep 1973.

Miscellaneous tests in support of NRX-A6, R-1, XE-1 and XE-2 reactors are reported: coolant flow distribution in control drums and reflector, fuel element development, orifice calibration, graphite component corrosion, creep, wrapper and periphery support evaluation, seals, etc. Test facility modifications are reported. (LTN)

16468 (WANL-TME-1769) TECHNICAL REVIEW NERVA NUCLEAR SUBSYSTEM. NRX-A6 TEST PERFORMANCE PRESENTATION, FEBRUARY 27–28, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1968. 232p. Dep. NTIS $14.75.

Declassified 11 Sep 1973.

The successful performance of the NRX-A6 reactor major components and fuel elements is reviewed in slides and graphs, with emphasis on what was learned and on identifying problems still needing further work. (LTN)

16469 (WANL-TME-1774) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON MARCH 28, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1968. 68p. Dep. NTIS $6.50.

Declassified 11 Sep 1973.

Testing during this period supported the NRX-A6, XE-PRIME and PEWEE reactors. Many fuel elements were tested, including some of hydrolyzed fuel elements, process development tests and some load and cusp measurements on fuel elements. Other tests involved support blocks, pyrofoil seals and other core periphery components. Neutron reflectors (beryllium) were investigated with respect to failure and fracture properties (cracks have occurred in some areas of the reflectors due to thermal stresses during reactor tests, so the possible degree of growth or propagation of such cracks is being investigated). Miscellaneous other tests and test facility developments are reported. (LTN)

16470 (WANL-TME-1776) SUMMARY FABRICATION REPORT FOR NRX-A6 FUELED ELEMENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 3 May 1968. 45p. Dep. NTIS $5.25.

Declassified 11 Sep 1973.

The production history of the fueled elements and reactor support hardware for the NRX-A6 core is summarized with particular emphasis being placed on specific problem areas encountered and their solutions, development and implementation of new or revised processing techniques, and production schedule records. (auth)

16471 (WANL-TME-1785) R-1 PARAMETRIC SHIELD STUDIES ON PAX: REACTIVITY WORTH OF MOCKUP BORATED ALUMINUM–TITANIUM HYDRIDE SHIELDS. Huen, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1968. 18p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

16472 (WANL-TME-1793) TEST SPECIFICATION ID_bGED COATING DEVELOPMENT FOR PEWEE-1. Final Report. Wilks, P. H.; Slater, L. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 May 1968. 28p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

The purpose of the specification was to define a diffusion-controlled coating process for high void fraction fuel elements which would represent an improvement over A6 coating technology and provide a thicker hot end coating capable of higher temperature performance. This was accomplished by introducing the coating stream from the serial numbered end of the fuel element. The temperatures were adjusted so that the midband coating was deposited at a lower temperature than in A6 production. A thicker hot end coating was also obtained. It was found that this could be accomplished in two different ways. A gas stream of the composition employed for NRX-A6 coating could be used, or the hydrogen-to-salt ratio in the coating stream could be increased to 2.25. The former approach required 24 hours of coating time, whereas the latter approach required only 14 hours of coating time. A comparison was made of the two concepts, and no significant differences were found in the products obtained. Consequently, the shorter, more convenient, high hydrogen, 14-hour procedure was adopted for the Pewee-1 diffusion coated elements. (auth)

16473 (WANL-TME-1794) WANEF CRITICAL EXPERIMENTS IN SUPPORT OF NERVA. Quarterly Report, 4th Quarter CY 67. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1968. 104p. Dep. NTIS $8.25.

Declassified 11 Sep 1973.

Work was performed in support of the NRX-A6 and XE-1 reactors using the PAX-E reactor. These experiments included: (1) determination of reactivity worths in the core and reflector and the worth of external structures to assist in the NRX-A6 shimming analysis; (2) measurements of the NRX-A6 control instrumentation in a simulated NRX-A6 nuclear environment; (3) a Calibration of the NRX-A6 neutron rate sensors; (4) measurements of the effects of the Test Cell "C" facility shield on the gamma and fast neutron fluxes in the pressure vessel, mockup shield, reflector, and vane regions of the NRX-A6 reactor; and (5) radiation streaming measurements through a mockup of the XE-1 external engine shield. Measurements were also performed on the Flexible Critical Experiment (FCX) reactor to supplement measurements made during CY 1966. Reactivity coefficients of uranium, graphite, and hydrogen were measured at several radial positions in both the core and graphite reflector. Extensive measurements of the radiation environment of FCX were also made using a variety of detectors to determine thermal neutron flux, fast neutron flux and dose rate, and gamma dose rate. (auth)

16474 (WANL-TME-1796) NRX-A6 POST-OPERATIVE MECHANICAL COMPONENT EVALUATION. Muth, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1968. 202p. Dep. NTIS $13.25.

Declassified 11 Sep 1973.

Upon completion of the NRX-A6 successful 60-minute full power test in December 1967, the reactor was disassembled and given a post-operative mechanical evaluation. The objective of the evaluation was to determine the design adequacy of the reactor components by their post-test condition. This post-operative evaluation verified areas of new design that met all of the NRX-A6 performance and design requirements. These areas included the following: Skirtless support blocks, composites (75/25 wt.%) and tungsten (vapor deposited with 2% thoria) corrosion protection cups, particle catcher assembly, exit gas thermocouple, fully exterior coated central element, anti friction slip plate, core radial displacement gage, lateral support tapered seal segment, lateral support coil spring, and individual flow screens. Post-operative examination of the beryllium reflector rings, grafoil wrapper, hot filler strips, and filler strip keys indicated the performance objectives of the NRX-A6 were met. The results provide a basis for further design development of reactor components for the NERVA Nuclear Subsystem. (auth) •

16475 (WANL-TME-1798(Vol. 4)) NUCLEAR ANALYSIS. Volume IV. Doncals, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Jun 1968. 186p. Dep. NTIS $12.50.

Declassified 11 Sep 1973.

The nuclear analysis of the NERVA I Reactor and its structural components defined as Engineering Critical Components (ECC) is presented. Nuclear Subsystem nuclear requirements are reviewed and the NSS Nuclear and Radiation Environment Drawing which will be utilized to present the key environmental conditions for all operating and non-operating conditions is discussed. The overall nuclear characteristics of the reference nuclear reactor, the nuclear analysis performed on the candidate designs for each ECC, nuclear requirements for each ECC and an analysis section are given. This latter section includes the methods, key assumptions, analysis results and the pros and cons from the nuclear standpoint of each of the designs being evaluated. (auth)

16476 (WANL-TME-1852(Vol. 1)) WESTINGHOUSE ASTRONUCLEAR EXPERIMENTAL FACILITY. Volume I. R-1 Parametric Shield Measurements Conducted on the NERVA Permanent Assembly Experiment (PAX) Reactor. Oblock, V. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1969. 340p. Dep. NTIS $20.00.

Declassified 11 Sep 1973.

Shielding and nuclear measurements have been performed using a critical assembly mockup of the NERVA nuclear rocket reactor to provide early shield design information in support of the NERVA R-1 Nuclear Subsystem. The experimental apparatus is described and selected measurement results are presented. Selected computer autoplots of the active dosimetry measurements are also presented. The configurations for which data were obtained were mockups of all or selected combinations of

the cluster plate, support plate, dome-plenum, pressure vessel and BATH (reference shield material of boron-aluminum-titanium hydride). Measurement of neutron flux density, fast neutron and gamma absorbed dose rates, and fast neutron spectra were made internal and external to selected combinations of these components. The effect of the fission density internal to the PAX-E5 core due to the addition of these components on the bare core was also determined. Reactivity and drum worth changes were also measured. Test cell-induced background was determined by shadow shields. These results were subtracted from the environmental data to obtain the direct radiation (for simulated space conditions). Boral enclosures were utilized to minimize thermal neutron flux density background at locations in close proximity to the reactor assembly. Measurements of the thermal neutron flux density distribution and secondary gamma ray production from the test cell walls were made to determine relative secondary source strengths and distributions. Measurements were made to determine the radiation perturbation due to a simulated propellant tank containing two densities of polyethylene to simulate the neutron and photon transport properties of liquid hydrogen. (auth)

16477 (WANL-TME-1855) ENGINEERING DATA AND DESIGN REVIEW (JULY 16 AND 17, 1968). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Aug 1968. 470p. Dep. NTIS $26.50.

Declassified 11 Sep 1973.

Design alternates were presented and the proposed design approaches for major NERVA components reviewed. Test results were presented for several components, stress analyses for others and fuel element developments were reported. Emphasis was on the design requirements and how the designs satisfied these requirements. (LTN)

16478 (WANL-TME-1863) NX-A6 TRANSDUCER EVALUATION REPORT. Burlas, T. C.; Karako, E. F.; Myers, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1968. 151p. Dep. NTIS $10.75.

Declassified 11 Sep 1973.

A total of 265 WANL supplied sensors were used for measurements on the NRX-A6 reactor and 259 of these operated throughout. The majority of these measurements were identical to those performed on previous reactor tests. New measurements or those that required redesigned transducers were as follows: Core radial displacement measurements were made successfully with new transducers designed and fabricated at WANL and used for the first time on NRX-A6; cluster exit gas temperature measurements were made successfully for the first time during a reactor test; the successful use of a liquid nitrogen (LN_2) reference junction dewar installed in the test car privy rather than in the test cell; and a side by side actuator test that required the measurement of pressure, temperature and vibration to aid in the evaluation of the actuator test parameters. Two transducer evaluation tests were performed: Pressure transducer evaluation test which consisted of two redesigned, open case type, variable reluctance transducers and one thin film, bonded strain gage transducer installed on the reactor core support plate and shield; and rate sensor fast neutron and gamma detectors used to perform active radiation measurements. Detailed experience and test results are given for the following types of instrumentation: temperature sensors, strain gages, calorimeters, linear variable differential transformers, pressure transducers, accelerometers and rate sensors. (auth)

16479 (WANL-TME-1904) RELATIONSHIP BETWEEN BRAZING PROCESS VARIABLES AND GEM-MOLYBDENUM JOINT QUALITY FOR A CHROMIUM–NICKEL–GOLD BRAZE ALLOY. Seaman, F. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 29p. Dep. NTIS $4.50.

Declassified 12 Sep 1973.

Present NERVA reactor design requires the brazing of the metal orifices into graphite fuel element channels. In this study, a series of NbC (GEM)-Molybdenum Orifice-AuCrNi braze alloy assemblies was produced, leak tested, and then sectioned for metallographic evaluation in order to determine the interaction between the independent process variables of brazing temperature, time at brazing temperature, and gap between the wall of the coated channel and the cylindrical surfaces of the orifice. The interaction was established in terms of defective brazes—a dependent variable. The results of the interaction were displayed graphically as a response surface. A response surface is useful in determining, visually in this instance, the sensitivity of the dependent variable to changes in the independent variables. (auth)

16480 (WANL-TME-1937) PERFORMANCE OF WANL SUPPLIED FUEL ELEMENTS IN PEWEE-1. Simmons, C. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1969. 146p. Dep. NTIS $10.50.

Declassified 12 Sep 1973.

The results of detailed post-operational examination and performance analysis of WANL-supplied, PEWEE-1 fuel elements are described. It was found that interpretations of fuel performance were complicated by surface corrosion and fuel bead hydrolysis effects. After these effects were considered, the general bore performances of all WANL elements were found to be uniformly good and qualitatively as predicted by the qualifying electrical corrosion test data. Surface corrosion losses were found to be primarily related to the thickness of OD NbC coatings; the thicker the coatings the lower the losses. Fuel bead hydrolysis effects in WEFF-GEM coated elements produced pinhole and/or corrosion pocket damage which in turn was found to be related primarily to NbC bore coating defects, cracks and/or thickness parameters. (auth)

16481 (WANL-TME-1962) NUCLEAR SUBSYSTEM THROTTLING. Thompson, R. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1969. 17p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The results of an evaluation of throttling at high specific impulse (at rated chamber temperature) are presented. The objective was to analyze the NSS, high I_{sp}, throttling performance, its effects on NSS design and to establish a recommendation on high I_{sp} throttling based upon these analyses. The evaluation of the effects of high I_{sp} throttling on the NSS resulted in the recommendation that no specific requirement for high I_{sp} throttling operation by imposed on the design. This recommendation is based on the fact that no major advantage was identified for throttling, while incorporation of throttling requirements adversely affects the NSS design and reliability. The most significant NSS penalty is that of fuel corrosion. The requirements on the SSCV and control drum span are more severe for throttling than for the no-throttling case. Another significant disadvantage is the requirement for a more complex control operating mode over the no-throttling case. This recommendation does not rule out the fact that capability for high I_{sp} throttling may exist in the final design and that capability for reduced temperature throttling will certainly exist. However, because of the relative advantages and disadvantages identified, any throttling in the final design should be only that which is available in the most reliable and best performing NSS and based upon rated condition considerations. (auth)

16482 (WANL-TME-1964) NERVA NUCLEAR SUBSYSTEM PARAMETRIC PERFORMANCE EVALUATION. Trade Study No. 710. Holman, R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1969. 32p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

The evaluation and analysis of projected NERVA flight engine NSS specific component and overall NSS performance at rated power conditions has resulted in the performance estimates and variation uncertainties summarized. Sensitivity factors for the pertinent NSS parameters to permit evaluation of the NSS performance at off-nominal rated engine conditions have also been developed. These data constitute all NSS data requirements needed for evaluations of the reference engine system at steady state rated power. They are presented as the probable minimum specific component limits, on a $\pm 3\sigma$ basis, which could be expected without a significantly increased effort in improving the state-of-art beyond improvement levels projected for the flight engine NSS components. The data are the recommended estimates of NSS parameter performance variations as required for the hot bleed cycle system study. These are based upon the explicitly specified, rated inlet conditions. Effects of variation in these inlet conditions are presented as partial derivatives to permit off-design study. These data satisfy all the requirements for the trade study scope as outlined. (auth)

16483 (WANL-TME-1980) DETERMINATION OF NOMINAL T_c FOR 4500°R MINIMUM. Holman, R. R.; Severson, W. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1970. 45p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

The nominal chamber inlet temperature, T_c, required for the NERVA hot bleed cycle reference engine to assure the NPRD-1 specified rated performance is established. The nominal T_c determined for the specified 4500°R minimum chamber temperature was 4563°R for the flight engine. This was based upon the estimated accuracy with which the true NSS exit temperature for the flight engine could be measured and controlled. It was further determined that to assure the engine minimum rated specific impulse requirement of 825 seconds would require nominal T_c of 4625°R. The NSS exit gas temperature and fuel temperature levels resulting were found to be inconsistent with the high NSS reliability requirements stipulated in NPRD-1 based

upon extrapolated NRX-1 technology. A review of these requirements and a nominal T_c for the NERVA flight engine of 4500°R is recommended. (auth)

16484 (WANL-TME-2654) PRODUCTION ENGINEERING ANALYSIS OF NRX-A5, NRX-A6, XE-2, AND PW-1 MANUFACTURING CAMPAIGNS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1969. 28p. Dep. NTIS $4.50.

Declassified 10 Sep 1973.

The results of a production engineering analysis of fuel element manufacturing difficulties experienced during the NRX-A5, NRX-A6, XE-2, and PW-1 manufacturing campaigns are reported. These four campaigns covered the time period from June 1965 to April 1968. Particular emphasis was placed on specific problem areas encountered, their solution, and recommendations for continued improvements. (auth)

16485 (WANL-TME-2711) DATA RETRIEVAL SYSTEM TRADE STUDY. Jones, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1970. 40p. Dep. NTIS $5.00.

Data Management is a necessity for the NERVA Program because of the vast quantity of data required for proper program management. To satisfy the program management requirements, data must be traceable and visible not only to the formal documents, data items, drawings and specifications, but in many cases, to the raw data. WANL Data Management must assure that these data are in a form conducive to efficient storage and rapid retrieval. Because efficient storage, rapid retrieval and dissemination of data are needed, a trade study was undertaken to determine the most efficient and effective method to perform these functions. Phase I trade study results indicate that microfiche and microfilm aperture cards (tab card size) are the preferred media/method. Phase II of the study indicates that an Automated System for Storage and Retrieval of Data (ASRD) system concept is preferred. As a result of the Phase II study, a specification was prepared so that active procurement of the ASRD may be initiated. (auth)

16486 (WANL-TME-2753) THERMAL AND FLUID FLOW ANALYSIS REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1971. 639p. Dep. NTIS $35.00.

Declassified 11 Sep 1973.

Thermal and fluid flow analyses are presented to document the detailed analyses conducted to derive and establish the performance and design requirements for the Nuclear Subsystem and its Engineering Critical Components. This Data Item establishes and substantiates the appropriate parameters of the selected design and provides the source for steady state and transient data used in the detail thermal and structural analyses. This Data Item report gives a summary of the applicable specifications relevant to the thermal design, a description and derivation of the analytical models and methods, the maturity of the input data, the validity of the analytical methods, and the interpretation and analysis of the resulting steady state and transient data. (auth)

16487 (WANL-TME-2760) FUEL ELEMENTS. Zwillich, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1971. 41p. Dep. NTIS $5.25.

Declassified 11 Sep 1973.

A trade study was made for the purpose of evaluating two fuel element design approaches and selecting a fuel element design for the R-1 reactor*. It evaluates fuel elements of standard geometry configuration; i.e., geometry similar to NRX reactors. The materials considered are high expansion graphite and composite. The evaluation and selection is made through a comparison matrix in which the ability of each design approach to meet the requirements is objectively evaluated and the design approach having the highest potential to meet the functional, technical and programmatic requirements is selected. The design of the fuel element selected for the R-1 reactor is the Composite Fuel Element. The selection is based on this design's better performance with respect to reactivity loss. The smaller reactivity loss of the Composite Fuel Element offers a better potential for meeting the required life of the R-1 reactor. Also, the Composite Fuel Element has a higher reliability and safety value. (auth)

16488 (WANL-TME-2768) SYSTEMS ANALYSIS SUMMARY REPORT, NUCLEAR SUBSYSTEM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1971. 694p. Dep. NTIS $37.75.

Declassified 12 Sep 1973.

Analysis and results are presented which detail the systems analysis conducted to derive and establish the performance and design requirements for the Nuclear Subsystem (NSS) applicable to the NERVA Engine Subsystem, components, and equipment and facility specifications; establish and substantiate appropriate parameters of the selected design; and provide the source for steady-state and transient data. A brief summary of applicable performance requirements of the NSS and Structural Support Coolant Assembly (SSCA) specifications, a description of models used in the analysis, and transient and steady-state data which illustrate the degree of compliance with these performance requirements are included. (auth)

16489 (WANL-TME-2769) STRUCTURAL SUPPORT COOLANT ASSEMBLY EVALUATIONS. Lee, W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1971. 34p. Dep. NTIS $4.75.

Declassified 12 Sep 1973.

Structural Support Coolant Assembly (SSCA) requirements under normal and malfunction conditions are described, leading to permissible leakages, valve rates, and emergency procedures. Special operating procedures required under malfunction conditions are described. (auth)

16490 (WANL-TME-2774) WESTINGHOUSE PRD PRESENTATION. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Dec 1970. 550p. Dep. NTIS $30.50.

Declassified 12 Sep 1973.

A Preliminary Design Review (PDR) meeting was held on December 21-22, 1970, to present a brief summary of the draft data items for the Nuclear Subsystem. At his meeting the major requirements that had to be satisfied, the designs prepared in accordance with the requirements, and the methods used in analyzing the designs and key results from the analyses were described. In addition, conclusions and recommendations for future action were presented. (auth)

16491 (WANL-TME-2788) SUMMARY FABRICATION REPORT FOR PEWEE-2 FUELED ELEMENTS. Kilp, G. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1971. 48p. Dep. NTIS $5.50.

Declassified 12 Sep 1973.

The production of components for the Pewee-2 reactor began on June 27, 1969 and shipment of all prime and experimental elements for the core was completed on schedule on July 3, 1970. This fabrication campaign began without preproduction and with two new high expansion graphite flours: AXM for the standard elements and AXF for the experimental elements. In addition to these new materials, several new or modified processes were used and quality control procedures were modified. All UCCND (Y-12) fabricated elements were coated at WNCO because the Y-12 coating process would not meet the corrosion test requirements. In addition, all support hardware for the Pewee-2 core and associated test programs were coated and shipped. (auth)

16492 (WANL-TME-2790) WESTINGHOUSE ASTRONUCLEAR LABORATORY CONTRIBUTION TO THE THIRTY-SECOND HIGH TEMPERATURE FUELS COMMITTEE MEETING, 11-13 MAY 1971. Fleischer, L. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1971. 17p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

The successes of the NERVA technology program have led to a steady increase in performance requirements. These have been matched by a steady upgrading of reactor capabilities. From the early tests, the KIWI series and NRX-A2, which demonstrated reactor life-times of a few minutes before the fuel came apart, the improvement has been remarkable. NRX-A6 was operated for the planned 60 minutes and still had sufficient reactivity to expect another hour's operation. XE-Prime confirmed these data. In keeping with historical precedent, new, more difficult goals have been set: a multiple restart capability and longer cumulative operating time, 60 operating cycles of 10 minutes duration are desired. A complete reactor design review was made as a result of the new goals. Many design changes and many materials changes have been specified. After a study in which seven fuel element candidates were evaluated, a carbide/graphite composite fuel concept was selected. The first phases of the plan to develop this fuel are reported. (auth)

16493 (WANL-TMI-285) FORMULATION OF EXPRESSIONS TO BE PROGRAMMED FOR THE CALCULATION OF NUMBER DENSITIES. Sullivan, F. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Sep 1962. 8p. Dep. NTIS $4.00.

The INPUT code will prepare and output atom number densities starting from basic reactor geometrical data. If number density cards are desired for regions of cores for which the number densities have previously been calculated, the user can simply input information specifying core, and core region desired and what type of output cards are to be prepared (MUFT and TNS).

In order to handle cases in which number densities are desired for cores in which the number densities have not already been calculated, a library of elements will be included. This will be composed of the MUFT and TNS libraries plus HfC, TiC, NbC, and B4C. This library will contain the density and atomic mass of each of these elements. Avogadro's number (Na) will also have to be stored. Provision will be made for adding new elements as needed. (auth)

16494 (WANL-TMI-300) SAMOOM CODE. Duckworth, G. D.; Sullivan, F. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Oct 1962. 6p. Dep. NTIS $4.00.

The SAMOOM code calculates gamma and neutron heating rates (H_γ and H_n) at points in reactor components for times during startup, operation, or shutdown for any operating history. It also sums H_γ and H_n to obtain total heating rates H_T by point for various times. (auth)

16495 (WANL-TMI-305) TNS II SUBROUTINE PUCH. Sullivan, F. E.; Stevens, C. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Oct 1962. 6p. Dep. NTIS $4.00.

A program (PUCH) has been written as a subroutine of the TNS cross section code to prepare cross section input cards for DSN. (auth)

16496 (WANL-TMI-316) DETERMINATION OF COEFFICIENT OF FRICTION. Vandergrift, E. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Oct 1962. 10p. Dep. NTIS $4.00.

Preliminary measurements of the coefficient of friction between two pieces of NERVA core graphite are reported: A change in the normal force from 10 to 2 psi has no significant effect. The value is not changed by vacuum alone, but can be increased by prolonged degassing at high temperatures. On cooling the coefficient gradually decreased with time (even when kept under vacuum). A decrease in the value on repeated testing may be due to specimen wear. (LTN)

16497 (WANL-TMI-336) PRELIMINARY ANALYSIS OF WANL RADIATION EFFECTS EXPERIMENT AT NARF-GD/FW. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Oct 1962. 8p. Dep. NTIS $4.00.

Most of the pressure transducers failed at NVT less than 2×10^{16} n/cm^2. The strain gages tested had little or no change in resistance but the insulation resistance dropped markedly. The RTD's tested showed no apparent change. (LTN)

16498 (WANL-TMI-338) KIWI B-5 THERMOCOUPLE INSTRUMENTATION. Sheer, I.; Marlett, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Oct 1962. 6p. Dep. NTIS $4.00.

The tests demonstrated that the response characteristics of the sheathed thermocouple (T/C) in the thermowell lagged the fast responding T/C by 20 to 30° up to temperatures of 550°F and by 10 to 15° from temperatures of 600 to 1100°F. It was also found that a T/C's output critically depends upon the nature of the contact between the specimen whose temperature is to be measured and the T/C tip. Errors of over 100°F were encountered when the fast responding T/C's tip was not in intimate contact with the stainless steel block. This effect, though still important, was less noticeable with slower responding T/C's. A correction factor was necessary on account of the low input impedance of the recording system. (auth)

16499 (WANL-TMI-344) FLUID FLOW AND TRANSIENT HEAT TRANSFER OF GASEOUS HYDROGEN AT LOW TEMPERATURES. Chi, J. W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 23p. Dep. NTIS $4.25.

As part of a program to study liquid hydrogen cool-down and forced convection, transient boiling, heat transfer to hydrogen in a single tube, cold gaseous hydrogen runs were made to study the characteristics of the test apparatus. The results have shown that: The orifice meter can be used with confidence to measure the flow-rates of single phase, gaseous hydrogen; and the experimental local heat transfer coefficients for single phase heat transfer can be correlated by well-known equations. (auth)

16500 (WANL-TMI-346) NRX-A1 NOZZLE END SEAL. Villasor, A. P. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Oct 1962. 6p. Dep. NTIS $4.00.

Based on the Navier-Stokes equations of motion for viscous flow, an upper limit is established for the leakage of hydrogen at the nozzle-end seal. (auth)

16501 (WANL-TMI-346(Add. 1)) NRX-A1 NOZZLE END SEAL. Villasor, A. P. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Oct 1962. 7p. Dep. NTIS $4.00.

The hydrogen leakage of the nozzle-end seal is re-examined on the basis of a frictionless, adiabatic "nozzle" flow. Curves are drawn and compared with those previously obtained. (auth).

16502 (WANL-TMI-347) NUMERICAL SOLUTION OF TRANSIENT TEMPERATURE DISTRIBUTION IN CONCRETE WALL TO TEST CELL "A" DUE TO GAMMA HEATING. Garrett, N. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Oct 1962. 16p. Dep. NTIS $4.00.

The temperature distribution in the concrete wall of Test Cell "A" at NTS resulting from exposure to gamma radiation during a full-power NERVA test run was calculated. A maximum temperature of approximately 260°F occurs ½" from the exposed face of the wall after a 20 min. gamma exposure. Temperature gradients of about 22°F per inch exist in the first 6 inches from the exposed face after a 20 min. gamma exposure. 50% of the energy from gamma heating is deposited in the first 3 inches of concrete from the exposed face. 94% is deposited in the first 12 inches. (auth)

16503 (WANL-TMI-354) THERMAL STRESS CONSIDERATIONS IN FUEL CLUSTER SUPPORT COMPONENT. El-Waziri, A. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Nov 1962. 6p. Dep. NTIS $4.00.

From the temperature distribution in the support element, thermal stresses are calculated and superimposed on the loading stresses. (LTN)

16504 (WANL-TMI-355) KIWI B-5 SHIELD CAPSULE PELLET ALIGNMENT. Schreiber, J. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Nov 1962. 10p. Dep. NTIS $4.00.

A model shield capsule was vibrated longitudinally to determine the relative motion between pellets whose surfaces were not parallel. No relative motion was observed for frequencies between 20 and 30 cps. At higher frequencies the motions were quite irregular with no definite alignment occurring. The amplitude of the vibrations was .100 inch. (auth)

16505 (WANL-TMI-359) CORE SUPPORT BLOCKS. Parsons, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Oct 1962. 4p. Dep. NTIS $4.00.

Results of loading tests of NRX-A1 support blocks are reported. (LTN)

16506 (WANL-TMI-412) NRX-A-1 SHIELD NOZZLE END SUPPORT PLATE, SEAL FLANGE, AND BAFFLE RING TEMPERATURES. Black, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Dec 1962. 4p. Dep. NTIS $4.00.

Temperature distribution in the nozzle end support, seal flange, and baffle weldment assembly is given. The temperature in the seal flange is approximately 20° hotter than the support plate. (auth)

16507 (WANL-TMI-419) COMPARISON OF EXPERIMENTAL DATA WITH COMPUTER CALCULATED VALUES FOR SINGLE PHASE FLOW AND TRANSIENT HEAT TRANSFER TO GASEOUS HYDROGEN. Chi, J. W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Dec 1962. 9p. Dep. NTIS $4.00.

Comparisons between experimental data obtained from single-phase gaseous hydrogen cool-down with those computed from a computer program have shown excellent agreement. It has been concluded on the basis of these results that a high degree of confidence can be placed on: The experimental results from the test loop, and the computer program for single-phase gaseous hydrogen flow and heat transfer. (auth)

16508 (WANL-TMI-1171) SPECIAL ASTROFUEL COATING DEVELOPMENT PROGRAM. Feild, A. L. Jr.; Bartholomew, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Jul 1964. 34p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

The evaluation of NbC-coated production fuel elements for the NRX-A2 reactor has disclosed the need for a general improvement in the adherence and corrosion performance of NbC coatings for the NRX-A3 and subsequent reactors. A series of ten coating development runs was conducted following the completion of NRX-A2 fuel element production. The objectives were to improve bore and end coats of standard elements, evaluate the coating of non-fuel tips, and investigate effects of element fabrication and raw material variations on coating behavior. The runs were monitored on a continuous basis and detailed records were maintained on individual run conditions. Evaluation of coatings was performed by means of standard destructive and non-destructive tests and hydrogen corrosion testing. Analysis of accumulated data leads

to these conclusions: (1) non-fuel tips are practical and desirable for use on fuel elements. A superior coating is produced on the non-fuel tips, (2) a change in the present coating procedure will produce improved end coatings on both standard elements and non-fuel tip elements. This change would require initial coating at a 1900°C inlet temperature for the first 1½ hour of the run, followed by a drop as quickly as possible, to a 1600°C inlet temperature for the remainder of the run, (3) various other general operational improvements, which have been suggested in separate correspondence will help maintain reproducibility and quality of coating runs in each coating furnace. (auth)

16509 (WANL-TNR-003) REACTOR NUCLEAR DESIGN-NERVA PHASE I ACTIVITY. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 102p. Dep. NTIS $8.25.

Declassified 10 Sep 1973.

The analytical methods used for nuclear analysis, and the results obtained through their use, are described, including calculated power distributions, reactivity worths, and control vane worths for the B-1, B-2, and B-4 reactors. Nuclear radiation heating rates in the B-1 reactor components are obtained at various times after shutdown and for various shutdown programs. In addition, the solutions of several shipping and handling problems are presented. (auth)

16510 (WANL-TNR-004) REACTOR THERMAL DESIGN-NERVA PHASE I ACTIVITY. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 145p. Dep. NTIS $10.25.

Declassified 10 Sep 1973.

Preliminary thermal design information developed during the Phase I of Project NERVA, and consisting of a study comparison of the B-1, B-2 and B-4 type reactor cores, is presented. The effect of two flow systems through the reactor assembly has been considered; one is that system associated with the heated bleed engine cycle and the second is that required for the hot bleed engine cycle. Design parameters such as flow rates, pressures, and temperatures throughout the KIWI B-1A and proposed NERVA B-1 reactors were studied. The thermal analyses presented include the thermal characteristics of the reactor operating at steady state, startup transient, and decay-heat cooling conditions. Steady-state analyses include the thermal characteristics of the cores, the reflector and shield flow systems, and a discussion of "Hot Channel Factors" on the B-1A type reactor core. Startup transient studies comprise laminar flow studies and thermal gradient studies in the core. The decay-heat cooling problem is one of defining the optimum manner of cooling the reactor after shutdown to maintain integrity of the reactor with minimum integrated propellant flow. Development and improvement of calculation methods for defining the thermal characteristics has been done in parallel with the reactor thermal design. These calculation methods are summarized. (auth)

16511 (WANL-TNR-055) FAILURE MODE ANALYSIS SUMMARY: NERVA B-1 REACTOR. Neal, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Apr 1962. 34p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

In the preliminary design phase of the NERVA reactor, several basically different designs have been considered. One of these contains a top-supported core and is identified as the NERVA B-1 reactor design. Reliability, as stated in the NERVA contract, is of extreme importance. Because of this importance, a failure mode analysis of the NERVA B-1 reactor design was considered desirable. The results of the failure mode analysis are presented, and design changes to improve the reliability are recommended. (auth)

16512 (WANL-TNR-075) PRELIMINARY INVESTIGATION OF NERVA CORE DESTRUCT CHEMICALS. Roll, J. A.; Goodman, E. I.; Henninger, W. A.; Rothman, A. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1962. 41p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

A preliminary investigation has been completed on reagents which have potential for reducing the core of a NERVA reactor to the required particle sizes for burn-up upon re-entry. Reagents were selected for testing based upon their selectivity for reaction with UC_2. Promising reagents which have been tested include Br_2, Cl_2, BrF_3, and BrF_5. Further work on these reagents will include quantitative determination of the weight of reagent required for destruction and the determination of the effective temperature range of the reagent. It is also planned to screen additional reagents including BF_3, BCl_3, BBr_3, IF_5, ClF_3, CCl_4, CF_4, F_2, CrO_2Cl_2 and related compounds. (auth)

16513 (WANL-TNR-078) KIWI B-5 SHIELD. Volume I. Design and Fabrication. Eppley, C. R.; Thompson, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Dec 1962. 212p. Dep. NTIS $13.75.

Declassified 10 Sep 1973.

The mechanical design and manufacture of a nuclear shield for the NERVA engine are described. The preliminary NERVA shield design provided the basis of the KIWI B-5 shield design. Manufacture was completed and this shield will be tested in the Los Alamos Scientific Laboratory KIWI B-5 reactor. The NERVA Shield is located within the reactor pressure vessel between the core and the vehicle tank. The primary function of a shield in the NERVA engine is to limit the radiation heating of the propellant in the vehicle tank to an acceptable level. The shield also serves to limit the radiation heating and activation of the engine components located between the reactor and propellant tank. The KIWI B-5 Shield was designed for a heated bleed engine in which the shield would provide some heat for the turbine fluid. This design passes only a small percent of the engine flow through the three internal passes of the shield. This internal flow passes through the interspaces formed by adjacent cylindrical elements. These cylindrical elements contain lithium hydride pellets and a borated stainless steel pellet. This collection of cylindrical elements plus the shield enclosure comprise the attenuating mass of the shield. (auth)

16514 (WANL-TNR-078(Vol. 2)) KIWI B-5 SHIELD. Volume II. Radiation Design and Analysis. Capo, M. A.; Nassano, R. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Dec 1962. 61p. Dep. NTIS $6.25.

Declassified 10 Sep 1973.

The KIWI B-5 shield was designed as a prototype of the NERVA heated bleed shield. Its purpose is to reduce the radiation heating in the liquid hydrogen propellant by a factor of 10. The shield is located above the reactor core support plate entirely within the pressure vessel. It is comprised of lithium hydride and boronated stainless steel pellets and steel discs, encapsulated in steel tubing. Seven capsules in an hexagonal array are held together by tie plates at each end to form a module. These modules are held between upper and lower support plates to form the shield. The shield materials, thickness, radius, and general mechanical design were selected as a result of optimization studies. The KIWI B-5 shield composition selected was 63% by volume natural lithium hydride, 27% stainless steel, and 10% void for coolant passages. The shield had a uniform thickness of 31.4 cm over the core radius, with a conical lateral surface reducing to zero thickness at the beryllium outer radius. The KIWI B-5 radiation design and analysis is described. Part of the work involved modifications in the analytical methods used in the radiation analysis, which led to design changes in the shield which are described. The expected radiation environment outside the final KIWI B-5 shield design is presented, including total gamma ray dose rates and fast neutron fluxes (above 1 MeV) at many locations outside the pressure vessel. (auth)

16515 (WANL-TNR-086) KIWI B-5 SHIELD STRESS AND VIBRATION ANALYSIS. Volume I. Stancampiano, P. A.; Thompson, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Mar 1963. 91p. Dep. NTIS $7.75.

Declassified 10 Sep 1973.

The KIWI B-5 Shield represents the first generation of a shield for the NERVA project. The shield was analyzed for the thermal and pressure loads associated with the LASL KIWI B-5 Reactor experiment which is limited to ground operation. As an eventual component of the nuclear rocket system, the shield would see inertial and vibration loadings in flight due to booster operation and nuclear rocket operation. The severest inertial loadings and mechanical vibrations were anticipated to occur during boost; accordingly the shield was also analyzed for these more severe loadings. A discussion of the analysis and tests completed on each major component is presented. The effects of the coolant holes in the shield enclosure heads on stresses are discussed. The enclosure head stresses and deformations are determined for inertial and thermal loading. In the thermal analysis the redundant nature of the shield structure is considered. The modules, that fill the shield enclosure, are analyzed with respect to tie plate and stem strength for inertial, thermal, and vibration loadings. The effects of these loads and coolant gas pressure loadings on the lithium hydride capsules that form the modules are discussed. The thermal and pressure loading on the nozzle end head cooling baffle and the vibration analysis of the vessel dome baffle conclude the report. (auth)

16516 (WANL-TNR-092) DEVELOPMENT OF BATCH FORMULATION EQUATIONS FOR GRAPHITE FUEL ELEMENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Feb 1963. 13p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The development of equations for determining starting weights of the individual constituents of a batch mix necessary to achieve

finished fuel elements with the required uranium loading and carbon density is presented. Experimental values of uranium loading, carbon density and composite density are reported for fuel elements prepared from batches compounded in this way. A correction factor was added to permit calculation of the starting weights when the $PyCUC_2$ bead density varied, as it did in later work. (LTN)

16517 (WANL-TNR-099(Suppl. 1)(Add. 1)) REVIEW OF FCX, WANL-TNR-099, SUPPLEMENT 1, JULY 19, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Sep 1965. 30p. Dep. NTIS $4.50.

Declassified 10 Sep 1973.

A number of questions about design and operational features of the Flexible Critical Experiment are answered. (LTN)

16518 (WANL-TNR-128(Vol. 1)) REACTOR ANALYSIS OF NRX-A. Nuclear Analysis. Volume I of III. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1963. 252p. Dep. NTIS $15.75.

Declassified 10 Sep 1973.

The nuclear analysis is presented for NRX-A Block I reactors which will be tested in the upfiring position on a KIWI test car at Test Cell A of the Nuclear Rocket Development Station, Nevada. In the NRX-A, a mockup shield consisting of an aluminum block replaces the lithium hydride-steel flight type shield. The NRX-A fuel loading specifications are presented along with a geometric description and analytical model representing those aspects of the NRX-A design pertinent to the nuclear analysis. The nuclear characteristics presented include reactivity estimates, power distributions, control reactivity span, effects of reactivity shimming, reactivity changes during operation, kinetic parameters and poison shipping wire reactivity control. The calculational procedures used in the nuclear analysis are described. The limitations and accuracies of, and anticipated improvements in, these methods are discussed. A comparison of analytical predictions with experiments is included. (auth)

16519 (WANL-TNR-128(Vol. 2)) REACTOR ANALYSIS OF NRX-A. Radiation Analysis. Volume II of III. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1963. 455p. Dep. NTIS $25.75.

Declassified 10 Sep 1973.

The radiation analysis is presented for NRX-A Block I reactors which will be tested in the upfiring position on a KIWI test car at Test Cell A of the Nuclear Rocket Development Station, Nevada. In the NRX-A, a mockup shield consisting of an aluminum block replaces the lithium hydride-steel flight type shield. The radiation environment data inside the pressure vessel, and outside the pressure vessel for both the unperturbed environment and the environment perturbed by the test car privy roof shield are presented. Detailed radiation heating rates in all NRX-A components within the pressure vessel are presented. The calculational procedures used in the radiation analysis are described and the limitations and accuracies of, and anticipated improvements in, these methods are discussed. A review of available data on comparison of analytical predictions with experiments is included. Pertinent information describing the NRX-A with a flight type (lithium hydride-steel) shield is presented for use in analysis of the NERVA engine and RIFT vehicle (auth)

16520 (WANL-TNR-128(Vol. 3)) REACTOR ANALYSIS OF NRX-A THERMAL AND FLUID FLOW ANALYSIS. Volume III of III. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1963. 629p. Dep. NTIS $34.50.

Declassified 10 Sep 1973.

The NRX-A reactor will be tested in the upfiring position on the KIWI test car at Test Cell A of the Nuclear Rocket Development Station, Nevada. In the NRX-A a mockup shield, consisting of an aluminum block, replaces the lithium hydride-stainless steel flight type shield. The design requirements of the NERVA reactor, a general description of the NRX-A reactor assembly, the types of thermal and fluid flow problems encountered in the analysis, and the anlytical methods used in the solution of these problems are presented. The thermal performance of the reactor is described under steady state, startup, shutdown and cooldown operating conditions. Results of detailed thermal analyses on the components comprising the assemblies of the outer reflector, the inner reflector, the aluminum shield replacement, and the core are discussed. It is concluded from the work undertaken, within the limitations of analytical prediction, that the NRX-A reactor design is reasonably adequate for meeting the design requirements and performing satisfactorily under the considered operating conditions. Tests of various components under controlled conditions are currently in progress to check results of the analysis. (auth)

16521 (WANL-TNR-165) RADIATION ANALYSIS OF NRX-A2 BY VARIOUS METHODS. Capo, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Dec 1964. 131p. Dep. NTIS $9.75.

Declassified 11 Sep 1973.

Comparisons are presented of the application of various analytical techniques in the radiation analysis of the NRX-A2 reactor. The analytical techniques include one and two dimensional diffusion and transport theory, the Monte Carlo method, and the point kernel method. Comparisons with experimental data are included where available. As a result of these studies, possible reduction in uncertainty factors for radiation data are discussed, as well as ways of improving the accuracy of calculated radiation data. The effect of design changes in the NRX-A2 reactor on neutron heating rates and secondary gamma ray source terms is also reported. (auth)

16522 PROBLEMATICS OF NUCLEAR MERCHANT SHIPS. Llado Rodriguez, J. M.; Leira Rey, G. Energ. Nucl. (Madrid); 19: No. 93, 5-21(1975). (In Spanish).

From the viewpoint of the world economy as a consequence of the vertiginous increase of the price of petroleum, the present possibilities of nuclear energy for the propulsion of merchant ships are analyzed. After a review of the specific characteristics of naval nuclear reactors and of nuclear-propelled merchant ships, the situation of the nations advanced in naval construction is briefly discussed with specific application to the case of Spain. A possible program for the development of a Spanish nuclear merchant ship is outlined. (tr-auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 13907, 14245, 14246, 14261, 14262, 14273–14275, 14277, 14284, 14285, 14287, 14299, 14301, 14302, 14306, 14312, 14333–14335, 14337, 14504, and 16275.

16523 (AECL-4927) EFFECT OF SHORT FLUX SPIKES ON THE DRYOUT POWER. Groeneveld, D. C. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1975. 38p. Dep. NTIS (US Sales Only) $5.00. AECL $1.00.

The effect of short flux spikes on the dryout power was studied experimentally using directly heated tubes cooled by Freon-12. The results were combined with Freon-12 and water results obtained elsewhere, and a correlation for a correction factor, to express the reduction in critical heat flux (CHF) due to a flux spike, was obtained. The correction factor was found to depend strongly on the flow regime and heat flux spike characteristics. 25 references. (auth)

16524 (AED-CONF-75-003-002) INVESTIGATION OF THE PRESSURE OSCILLATIONS THAT OCCURED DURING BLOWDOWN IN THE PRESSURE SUPPRESSION SYSTEM OF THE MARVIKEN NUCLEAR POWER PLANT. Appelt, K. D.; Kadlec, J.; Wolf, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). 1975. 5p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

6 figs.; 10 refs.

Blowdown experiments were carried out in the Marviken reactor plant, Sweden, from August 1972 until May 1973. The object of the investigations was to determine the pressure oscillation field occuring on the floor of the condensation chamber with blowdown and thus dynamic stresses released on a membrane plate, as well as to determine the accompanying mass flows and the composition of the mixture. (GE)

16525 (AED-CONF-75-003-004) THERMO AND FLUID-DYNAMICAL PROCESSES IN REACTOR CONTAINMENTS DURING INCIDENTS. Brosche, D. (Bayernwerk A. G., Muenchen (F. R. Germany)). 1975. 22p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

7 figs.; 24 refs. With abstract.

Containment thermo and fluid dynamic processes following loss of coolant accidents in light water cooled and moderated reactors are examined. Following a description of the physical processes occuring in the various accidents and incidents, the possibilities for their mathematical simulation as well as corresponding experiments are briefly discussed. (GE)

16526 (AED-CONF-75-003-006) PROBLEMS REGARDING FUEL ROD BEHAVIOUR IN LOCA AND THEIR INVESTIGATION BY OUT-OF-PILE EXPERIMENTS. Class, G.; Hofmann, G.; Wiehr, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). 1975. 23p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

9 figs.

Three essential questions of reactor fuel rod behavior are examined: (1) Are the model concepts regarding the fuel rod deformations and hazards in the blowdown phase correct? (2) Are the model concepts regarding fuel rod failure in heating the pressureless reactor core with the simultaneous presence of steam and water in the flood phase sufficient? (3) In what manner do the cooling conditions change in the reactor core with existing cooling channel blockages, through clad blistering, and bursting compared to the undisturbed reactor core? (GE)

16527 (AED-CONF-75-003-007) HEAT TRANSFER TO STAGNATING FLUID IN TWO BWR BUNDLES OF DIFFERENT POWER. Gaul, H. P.; Hicken, E.; Loser, H.; Riedle, K.; Ruthrof, K.; Sarkar, J. 1975. 12p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

21 figs.

The processes occuring in the low-pressure phase of an accident are investigated for the BWR. Individually these are: (1) The long-term cooling of wetted rods by spraying; (2) the temperature behaviour of the rods with frothing of water in the bundle due to steam; and (3) heat transfer with spraying and/or flooding. (GE)

16528 (AED-CONF-75-003-008) HYDRAULIC TESTS ON CORE ELEMENTS OF THE SNR-300 WITH REGARD TO EMERGENCY COOLING. Granner, N.; Hansen, G.; Penny, W.; Voj, P. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1975. 25p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

13 figs.

Knowledge of the pressure drop characteristics of single core elements is of great importance for simulation of the emergency cooling processes in SNR-300, especially in the region of small Re-numbers. The experimental determination of the resistance coefficients of the individual types of core element is given. (GE)

16529 (AED-CONF-75-003-010) MAIN THERMO AND FLUIDDYNAMICAL ASPECTS OF THE SAFETY CONCEPT FOR THE SNR-300. Huebel, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1975. 28p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

14 figs.; 1 tab.

The safety concept of the SNR 300 is outlined and with this basis the main thermo and fluiddynamical aspects are pointed out. Three accident regions are considered: (1) external effects and larger inner disturbances such as fires and explosions; (2) the steam generator accident in which sodium and water react with one another within the generator; and (3) hypothetical power excursions which assumes a failure of the safety system. (GE)

16530 (AED-CONF-75-003-011) RESULTS OF EXPERIMENTAL BLOWDOWN STUDIES IN A CONTAINMENT MOCK-UP. Kanzleiter, T. (Battelle-Institut e.V., Frankfurt am Main (F. R. Germany)). 1975. 5p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

1 fig.

A series of time slopes of measured parameters from PWR containment tests are presented and discussed. The procedures in the high pressure system during blowdown are given by means of pressure, density and mass flow slopes. Depending on the mass flow slope during the first seconds of the blowdown, pressure differences are formed between the cracking space and the adjacent containment. The measured long-term distribution of the containment excess pressure is a maximum at the end of the blowdown. The pressure suppression due to condensation on the cold containment walls starts at the beginning of blowdown, although it at first is exceeded by the pressure build-up due to the blowdown. The pressure suppression is particularly effective in relatively small buildings with relatively large inner surfaces compared to the volume. Therefore, smaller maximum containment pressures are reached than in early plants. (GE)

16531 (AED-CONF-75-003-017) RECALCULATION OF VESSEL BLOW-DOWN EXPERIMENTS USING RELAP3. Schuetzle, R. (Dusseldorf, F. R. Germany). 1975. 11p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

14 figs.; 5 refs.

The BRUCH-D and RELAP3 codes analyze the processes in the primary circuit of a reactor during a loss of coolant accident. The blowdown experiments carried out by the Batelle Institute, Frankfurt, on a pressure vessel without internals are described. Calculations of two experiments were carried out with the RELAP3 program. The possible parameters were varied in order to study their influence on the calculated behaviour. (GE)

16532 (AED-CONF-75-003-018) ANALYSES OF THE THERMOHYDRAULIC BEHAVIOUR OF A PWR PLANT IN THE CASE OF MINOR RUPTURES IN THE PRIMARY COOLANT SYSTEM. Steinkamp, D. (Babcock–Brown Boveri Reaktor G.m.b.H., Mannheim (F. R. Germany)). 1975. 7p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

9 figs.

In order to analyse small ruptures, it is necessary to create a criteria to define the limit between small and large ruptures. One talks of small ruptures when the ruptured surface is so small that at no time during the course of the accident the core is completely exposed to the coolant. It is necessary for such ruptures to apply a very different procedure from that for the analysis of large ruptures. There is no refilling and reflooding phase independent of the blowdown phase such as with large ruptures. The core is permanently at least partially filled with coolant and the reflooding already takes place during the blowdown. As a result of the experience gained with the BBR system according to the above criteria, all ruptures having a rupture surface of $A \lesssim 500\ cm^2$ can be classified as small ruptures. (GE)

16533 (AED-CONF-75-003-019) THERMO AND FLUID-DYNAMICAL CONDITIONS ENCOUNTERED DURING INCIDENTS IN THE GAS-COOLED FAST BREEDER REACTOR(GCFR). Stelzer, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Allgemeine Technologie). 1975. 4p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

19 figs.; 1 tab.

A survey is given on the applied calculating technique and results for both incidents: (1) Total failure of the cooling system; and (2) behaviour with scram. (GE)

16534 (AED-CONF-75-003-020) RELIABILITY ANALYSES OF THE REVENTING SYSTEM OF THE SNR-300. Wehling, J.; Waldhoer, G. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1975. 12p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

6 figs.; 1 tab.

In the case of SNR accidents where activity is released within the containment, the reventing system has the task of sealing off the containment from the outer atmosphere. By adding a continuous steel cladding at a distance of about 12 cm to the containment, a zone is created which is kept at a reduced pressure of about 3 mb compared to the outer atmosphere by exhausting with circulators. The containment and the steel cladding are closed by activity signals at the start of the accident. The exterior reactor building has no sealing function. The circulators of the reventing system exhaust the gap between the containment and steel cladding and deliver back in the outer containment. (GE)

16535 (AED-CONF-75-003-021) THE AFTERHEAT REMOVAL SYSTEM OF THE HIGH-TEMPERATURE REACTOR HTR-1,160. Werthmann, H. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). 1975. 12p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

15 figs.

The HTR-1,160 MW(e) has two independent and diversely built systems to remove afterheat following operation and after accidents. The afterheat removal main system is identical to the main cooling system and is able to guarantee sufficient cooling with operational pressure as well as after a depressurization accident. The afterheat removal auxiliary system is a safety system and consists of three independent and not interconnected circuits. It is able to grarantee sufficient cooling with operational pressure as well as after a depressurization accident. (GE)

16536 (AED-CONF-75-003-022) RELIABILITY ENGINEERING. Methods and Applications in Reactor Engineering. Zeibig, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1975. 13p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

11 figs.; 6 refs.

The safe operation of a system is generally guaranteed by considering the safety factors in the design, production and operation. By taking these measures as well as by engineering judgement, it is not possible to exclude the failure of a technical system; however, one can come to statements of the following nature. The failure of a technical system is: (1) improbable; (2) can be excluded with a safety limiting probability; (3) is incredible; (4) need not be considered; or (5) is negligible. These quantitative probability considerations form the basis of the present safety philosophy in reactor engineering which has lead to a high state of safety. (GE)

16537 (AED-CONF-75-003-023) OBJECTIVE APPROACH IN THE SAFETY-RELATED ASSESSMENT OF NUCLEAR POWER PLANTS WITH HTRs. Gabriel, H. W. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). 1975. 8p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

2 figs.

In order to fulfill energy policy aims to increase the share of nuclear energy from 1% to 15% by 1985, about 40 nuclear power plants with a capacity of 50,000 MW(e) must be constructed. The task of justifying these goals to the public on the basis of safety and economic considerations is discussed. Licensing procedures with high temperature reactors are given as examples. (GE)

16538 (AED-CONF-75-003-024) DESIGN AND PLANNING OF EXPERIMENTS FOR BLOWDOWN SIMULATION WITH THE PROGRAMME SYSTEM SSYST. Sengpiel, W.; Gulden, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). 1975. 7p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

8 figs.; 5 refs. With abstract.

A fuel rod behaviour code has been developed. This program system SSYST (Sicherheits-System together with the LWR accident analyses is to predict the location, time and extent of possible arising fuel rod cladding tube defects. Furthermore, SSYST is to be used for predetermining and supporting the design and carrying out of the relative experiments. The predetermination of an out-of-pile blowdown experiment to investigate the fuel rod behaviour in a PWR loss-of-coolant accident is reported. (GE)

16539 (AED-CONF-75-003-026) THE PRESSURE SUPPRESSION SYSTEM OF THE KWU BOILING WATER REACTOR. Sobottka, H. (Kraftwerk Union A. G., Offenbach (F. R. Germany)). 1975. 14p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

20 figs.; 1 tab. With abstract.

A short survey of the design principle and the mode of operation of the pressure suppression system during reactor operation and after loss of coolant accidents is given. A model description of the processes during and after the blowdown of the vertical condensation tubes is examined. (GE)

16540 (AED-CONF-75-042-000, pp vp) CONSTRUCTIONAL MEASURES AGAINST EXTERNAL EFFECTS ON A NUCLEAR POWER PLANT. Liersch, G. 1975. (In German).

From VGB-conference: power plants and enviornment 1975; Essen, F. R. Germany (12 Mar 1975).

13 figs.

In VGB-conference: power plants and environment 1975. Reports of section C. (VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (F. R. Germany)).

Presented are the constructional lay-out criteria against extraordinary external effects (earthquake, aircraft crash, fire, cloud of gas from chemical detonations) on nuclear power plants in the FRG. (GE)

16541 (AED-CONF-75-042-000, pp vp) RADIOACTIVITY DISCHARGES FROM NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC. Boedege, R.; David, H.; Kluge, E. 1975. (In German).

From VGB-conference: power plants and environment 1975; Essen, F. R. Germany (12 Mar 1975).

3 figs.; 5 tabs.; 15 refs.

In VGB-conference: power plants and environment 1975. Reports of section C. (VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (F. R. Germany)).

Technical measures for the control of discharge rates and for the processing of radioactive wastes within the nuclear power plant are discussed and the discharge rates for the years 1972-74 are given. (GE)

16542 (AED-CONF-75-042-000, pp vp) RADIOACTIVITY MEASUREMENTS IN THE ENVIRONMENT OF TWO NUCLEAR POWER PLANTS IN THE NETHERLANDS. van der Lugt, G. 1975. (In German).

From VGB-conference: power plants and environment 1975; Essen, F. R. Germany (12 Mar 1975).

8 figs.

In VGB-conference: power plants and environment 1975; Reports of section C. (VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (F. R. Germany)).

The methods used at the nuclear power plants Dodewaard and Borssele for the measurement of radiation level (dose rate), dust activity, ^{131}I in air, contamination of grass and milk, and activity of the surface water and its biota are described. (GE)

16543 (AED-CONF-75-042-000, pp vp) SAFETY PHILOSOPHY IN THE PLANNING OF NUCLEAR POWER PLANTS. Stauber, E. 1975. (In German).

From VGB-conference: power plants and environment 1975; Essen, F. R. Germany (12 Mar 1975).

23 figs.; 12 refs.

In VGB-conference: power plants and environment 1975. Reports of section C. (VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (F. R. Germany)).

A brief survey is given on the present situation, objectives, planning concept, lay-out, construction, quality assurance of plant components, radioactivity discharge during normal operation, prevention and limitation of incidents, protection against external effects, and on a safety evaluation criterion. (GE)

16544 (ANL-75-27) STUDIES ON LMFBR SUBASSEMBLY BOUNDARY INTEGRITY. Crawford, R. M.; Marr, W. W.; Padilla, A. Jr.; Wang, P. Y. (Argonne National Lab., Ill. (USA)). May 1975. Contract W-31-109-Eng-38. 55p. Dep. NTIS $5.45.

Initial faults and their associated failure-propagation modes are identified with the use of safety-assurance diagrams. To put these initial faults into perspective, reactor operating experience is reviewed with particular emphasis on the fuel-melting incident in the Fermi reactor. The ability of the subassembly duct to withstand a pressure-pulse loading is reviewed, including recent analyses of local MFCIs and subassembly-duct mechanical response. In addition, the thermal and mechanical response of the subassembly duct to contact with molten fuel is reviewed and extended; the thermal response (meltthrough) is discussed in the light of more recent analyses, and the mechanical-response behavior (thermal-stress analysis) is extended into the plastic regime. The consequences of a localized failure of the subassembly duct is also analyzed. 28 references. (auth)

16545 (ANL-75-28) LIGHT-WATER-REACTOR SAFETY RESEARCH PROGRAM. Quarterly Progress Report, January-March 1975. (Argonne National Lab., Ill. (USA)). 13 Jun 1975. Contract W-31-109-Eng-38. 55p. Dep. NTIS $5.45.

Information on light-water-reactor safety is presented concerning heat transfer and fluid dynamics during loss-of-coolant accident, transient fuel response and fission product release program, and mechanical properties of zircaloy containing oxygen. (DCC)

16546 (ANL-8138) SAS2A LMFBR ACCIDENT-ANALYSIS COMPUTER CODE. Dunn, F. E.; Fischer, G. J.; Heames, T. J.; Pizzica, P. A.; McNeal, N. A.; Bohl, W. R.; Prastein, S. M. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-Eng-38. 351p. Dep. NTIS $10.60.

The SAS2A code is an integrated accident-analysis code that calculates the initial consequences of an accident, from steady-state, preaccident conditions up to the point of large-scale fuel motion or disassembly. The code starts with a steady-state thermal-hydraulics calculation to initialize the fuel temperatures, fuel and cladding thermal expansion, and the coolant temperatures, pressures, and flow rates. The code then starts a user-specified perturbation in power level or flow rate, and calculates transient temperatures in fuel, cladding, and coolant. Transient stresses and strains in the fuel and cladding, and transient coolant pressures and flow rates are also calculated, as well as sodium boiling, film dryout, cladding melting, and fuel melting. Neutron kinetics is handled with a point-kinetics approximation, with

reactivity feedback from the Doppler effect, fuel thermal expansion, sodium voiding, user-supplied table-lookup fuel slumping, and scram reactivity, as well as user-specified programmed reactivity. 18 references. (auth)

16547 (ANL-8140) ENERGY SOURCE AND FLUID REPRESENTATION IN A STRUCTURAL RESPONSE CODE–STRAW. Kennedy, J. M.; Belytschko, T. B. (Argonne National Lab., Ill. (USA)). May 1975. Contract W-31-109-Eng-38. 76p. AT.

Additional developments in the STRAW code for simulating the surroundings of a fuel subassembly in a reactor core are described. Two new elements are added to the existing program: a hydrodynamic finite element representing the plane motion of the fluid surrounding and within the subassemblies, and a superimposed superelement representing the effects of axial flow. An energy-source model is incorporated to model molten-fuel-coolant interactions (MFCI) or other possible energy-release sources. Also, an option for computing the internal energies of any element or groups of elements, the total kinetic and internal energies, and the external work of forcing functions was added. The new features were verified by comparing simple problems with results from existing programs. Results are also given for a series of studies on response of reactor-core subassemblies, with particular emphasis on the partitioning of released energy among the axial flow, accident subassembly, and surrounding subassemblies. 12 references. (auth)

16548 (BAW-10035A(Rev.1)) FUEL ASSEMBLY STRESS AND DEFLECTION ANALYSIS FOR LOSS-OF-COOLANT ACCIDENT AND SEISMIC EXCITATION. DeMars, R. V.; Steinke, R. R. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1975. 78p. Babcock and Wilcox, Lynchburg, VA.

Babcock and Wilcox has evaluated the capability of the fuel assemblies to withstand the effects of a loss-of-coolant accident (LOCA) blowdown, the operational basis earthquake (OBE) and design basis earthquake (DBE), and the simultaneous occurrence of the DBE and LOCA. This method of analysis is applicable to all of B and W's nuclear steam system contracts that specify the skirt-supported pressure vessel. Loads during the saturated and subcooled phases of blowdown following a loss-of-coolant accident were calculated. The maximum loads on the fuel assemblies were found to be below allowable limits, and the maximum deflections of the fuel assemblies were found to be less than those that could prevent the insertion of control rods or the flow of coolant through the core. (auth)

16549 (BAW-10081A) CALCULATION OF MAXIMUM FUEL ENTHALPY DURING ROD EJECTION ACCIDENT. Scott, J. F. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Aug 1974. 14p. Babcock and Wilcox, Lynchburgh, VA.

Two methods of calculating maximum fuel enthalpy during a rod ejection accident are set forth. Examination of the relative conservatisms of the two methods reveals that the values of fuel enthalpy are well below the threshold value for prompt fuel failure regardless of the method used. This report is applicable to 177-fuel-assembly plants which have operating licenses or are expected to receive operating licenses in 1974 (6 references) (auth)

16550 (BAW-10095A) BABCOCK AND WILCOX REVISIONS TO CONTEMPT, COMPUTER PROGRAM FOR PREDICTING CONTAINMENT PRESSURE-TEMPERATURE RESPONSE TO A LOSS-OF-COOLANT ACCIDENT. Hsii, Y. H. (Babcock and Wilcox, Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1975. 58p. Babcock and Wilcox, Lynchburg, VA.

The CONTEMPT computer program predicts the pressure-temperature response of a single-volume reactor building to a loss-of-coolant accident. The analytical model used for the program is described. CONTEMPT assumes that the loss-of-coolant accident can be separated into two phases; the primary system blowdown and reactor building pressurization. The results of the blowdown analysis serve as the boundary conditions and are input to the CONTEMPT program. Thus, the containment model is only concerned with the pressure and temperature in the reactor building and the temperature distribution through the reactor building structures. The program also calculates building leakage and the effects of engineered safety features such as reactor building sprays, decay heat coolers, sump coolers, etc. 11 references. (auth)

16551 (BNL-19978) DEVELOPMENT OF A COMPUTER CODE FOR THERMAL HYDRAULICS OF REACTORS (THOR). First Quarterly Progress Report, August 1, 1974–December 31, 1974. Wulff, W. (Brookhaven National Lab., Upton, N. Y. (USA)). Jan 1975. 66p. (RP-1038). Dep. NTIS $6.50.

The purpose of the advanced code development work reported here is to construct a computer code for the prediction of thermo-hydraulic transients in water-cooled nuclear reactor systems. The fundamental formulation of fluid dynamics is to be based on the one-dimensional drift flux model for non-homogeneous, non-equilibrium flows of two-phase mixtures. Particular emphasis is placed on component modeling, automatic prediction of initial steady state conditions, inclusion of one-dimensional transient neutron kinetics, freedom in the selection of computed spatial detail, development of reliable constitutive descriptions, and modular code structure. 30 references. (auth)

16552 (ERDA-31) COMPENDIUM OF COMPUTER CODES FOR THE SAFETY ANALYSIS OF LMFBR's (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Jun 1975. 189p. Dep. NTIS $7.60.

A high level of mathematical sophistication is required in the safety analysis of LMFBR's to adequately meet the demands for realism and confidence in all areas of accident consequence evaluation. The numerical solution procedures associated with these analyses are generally so complex and time consuming as to necessitate their programming into computer codes. These computer codes have become extremely powerful tools for safety analysis, combining unique advantages in accuracy, speed and cost. The number, diversity and complexity of LMFBR safety codes in the U. S. has grown rapidly in recent years. It is estimated that over 100 such codes exist in various stages of development throughout the country. It is inevitable that such a large assortment of codes will require rigorous cataloguing and abstracting to aid individuals in identifying what is available. It is the purpose of this compendium to provide such a service through the compilation of code summaries which describe and clarify the status of domestic LMFBR safety codes. (auth)

16553 (GA-A-13412) GCR SAFETY PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1975. Contract AT(04-3)-167. 58p. Dep. NTIS $5.45.

HTGR safety studies are described concerning seismic effects on control rod and reserve shutdown system performance, release of radionuclides due to reactor accidents, containment of core-released radioactivity, and flammability studies of gaseous mixtures during hypothetical accident conditions. (DCC)

16554 (IRS-W-11) LAYOUT OF NUCLEAR FACILITIES AGAINST EXTERNAL INFLUENCES. Partial Aspect: Parts of Aircraft Wrecks. Interim Report. Drittler, K.; Gruner, P.; Suetterlin, L. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Feb 1975. 24p. (In English, German). INIS.

6 figs.; 1 tab.; 12 refs.

The case of an airplane engine which impacts upon a nuclear facility structural part is discussed. Considerations concerning the probability for such an event are followed by estimations of the impact velocity of an engine which has been torn-off a fast flying military airplane during an accident. The penetration depths for concrete material and the protection thicknesses are determined. The load function resulting from impact of the engine upon a rigid wall is presented and variations of this function which may be caused by penetration effects are discussed. An example is presented showing that properly dimensioned structural parts are quite capable of withstanding the loads which result from impacting airplane engines. (auth)

16555 (JAPFNR-184) ANALYTICAL CODE "LOCK" ON A FEW CHANNELS-BLOCKAGE ACCIDENT. Ohtsubo, A. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1974. 59p. (N-251-74-32). Dep. NTIS (US Sales Only) $5.45.

Work performed under United States–Japanese Fast Reactor Exchange Program.

With this code, the velocity distribution of the coolant subsequent to insertion of a blocking matter is given as an input and only the thermal calculation intended to obtain the transient behavior in temperature of the coolant and cladding is performed. In the system which is the object of analysis with this code, the mass preservation of the coolant does not hold good. This is because since blockage accidents in a few channels are taken up as the object of analysis, mass preservation need not hold good near a blocked channel only, although mass preservation for the assembly as a whole needs to hold good. (auth)

16556 (MND-2516) INTERIM STATUS REPORT: NUCLEAR ROCKET SAFETY STUDY. (Martin Marietta Corp., Baltimore, Md. (USA)). 9 Apr 1961. 164p. Dep. NTIS $11.25.

Declassified 29 Aug 1973.

The analytical investigation has covered a number of areas of nuclear rocket safety. An operations analysis was performed in which the major safety problems were isolated for both suc-

cessful and aborted missions. An extensive aerothermodynamic analysis was performed in which the re-entry behavior of graphite was investigated. Reactor analyses were performed to examine the effects of immersion in hydrogeneous media, control malfunctions and reactivity as a function of core fragment size. The three countermeasures under investigation are anticriticality destruct, additives and thermochemical destruct techniques. The fission product inventory of the engine was computed for both ballistic and orbital injection missions and engine activation products were also computed. A parametric study was carried out on cloud dissemination factors for launch pad accidents. The orbital startup mission was examined in detail to ascertain the effects of thrust and guidance failures occurring after startup. (auth)

16557 (NP-20456, pp vp Paper 4) ENVIRONMENTAL EFFLUENTS FROM WASTE HEAT REJECTION. Pigford, T. H. (Univ. of California, Berkeley); Keaton, M. J.; Mann, B. J. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Effects of once-through cooling on the ecology of the water in the vicinity of the discharge are discussed and diagrams are presented to show waste heat rejection by once-through cooling at a light-water nuclear plant and a coal-fired power plant. Other topics discussed are evaporative cooling towers and spray cooling, cooling ponds, and dry cooling. Diagrams are presented to show waste-heat rejection by these methods at a light-water nuclear plant and at a coal-fired power plant. (HLW)

16558 (NP-20456, pp vp Paper 11) CONTROL OF NONRADIOLOGICAL RELEASES TO ATMOSPHERE AND SURFACE WATER. Rainwater, F. H. (Environmental Protection Agency, Corvallis, OR). 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

An analysis of limitations for waste heat and chemical releases from nuclear power plants is presented. Environmental impacts from the waste heat and chemical releases are listed. 6 references. (DCC)

16559 (NP-20456, pp vp Paper 24) COST/BENEFIT ANALYSES OF ENVIRONMENTAL IMPACT. Goldman, M. I. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

Various aspects of cost-benefit analyses are considered. Some topics discussed are: regulations of the National Environmental Policy Act (NEPA); statement of AEC policy and procedures for implementation of NEPA; Calvert Cliffs decision; AEC Regulatory Guide; application of risk-benefit analysis to nuclear power; application of the as low as practicable (ALAP) rule to radiation discharges; thermal discharge restrictions proposed by EPA under the 1972 Amendment to the Water Pollution Control Act; estimates of somatic and genetic insult per unit population exposure; occupational exposure; EPA Point Source Guidelines for Discharges from Steam Electric Power Plants; and costs of closed-cycle cooling using cooling towers. (HLW)

16560 (NUREG-75/032) OCCUPATIONAL RADIATION EXPOSURE AT LIGHT WATER COOLED POWER REACTORS, 1969–1974. Murphy, T. D.; Hinson, C. S. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Jun 1975. 20p. NTIS $3.25.

This report presents an updated compilation of occupational radiation exposures at commercial light water cooled power reactors for the years 1969 through 1974. The information is derived from reports submitted to the United States Nuclear Regulatory Commission in accordance with requirements of individual plant Technical Specifications and Part 20.407 of Title 10, Chapter 1, Code of Federal Regulations (10 CFR Part 20.407). The MAN-REM/UNIT for all LWR's in 1974 is less than the 1973 value. The grand average since 1969, however, continues to increase. No significant trend was indicated over the period of 1969-1974 in the mean value of MAN-REM/MEGAWATT-YEAR. (auth)

16561 (NUREG-75/058) REACTOR SAFETY RESEARCH PROGRAM. A Description of Current and Planned Reactor Safety Research Sponsored by the Nuclear Regulatory Commission's Division of Reactor Safety Research. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Jun 1975. 145p. NTIS $5.75.

The reactor safety research program, sponsored by the Nuclear Regulatory Commission's Division of Reactor Safety Research, is described in terms of its program objectives, current status, and future plans. Elements of safety research work applicable to water reactors, fast reactors, and gas cooled reactors are presented together with brief descriptions of current and planned test facilities. (auth)

16562 (ORNL-TM-4676) EXPERIMENT FOR ACCURATE MEASUREMENTS OF FISSION PRODUCT ENERGY RELEASE FOR SHORT TIMES AFTER THERMAL-NEUTRON FISSION OF ^{235}U AND ^{239}Pu. Dickens, J. K.; Peelle, R. W.; Maienschein, F. C. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 26p. Dep. NTIS $4.50.

An experimental program for definitive measurements of energy release from the gross mixture of fission products from fission of ^{235}U and ^{239}Pu by thermal neutrons is described. The safety program for light water reactors, including those which will utilize recycled plutonium fuel, requires knowledge of the time-dependent heat source furnished by the beta and gamma rays from the decaying fission products. Depending on the method of uncertainty assessment, the emission rate in the critical time range about 100 sec following fission for thermal-neutron fission of ^{235}U has an estimated standard error ranging from 8 percent to 15 percent with a probability between 1 percent and 5 percent of a deviation greater than 30 percent above the best estimate. The described program is designed to reduce this large uncertainty in the input heat term which would apply in a loss-of-coolant accident. 80 references (auth)

16563 (ORNL-TM-4877) LMFBR SAFETY AND CORE SYSTEMS PROGRAMS PROGRESS REPORT FOR OCTOBER–DECEMBER 1974. Fontana, M. H.; Wantland, J. L. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 99p. AT.

Program review, coordination, and activities are reported. Progress is reported under the following headings: analysis and data evaluation for Fuel Failure Mockup (FFM) bundle SD, water system mockup of the FFM, development of coolant channel blockage detection methods, FFM facility operations, and LMFBR electric heater development. (DCC)

16564 (ORNL-TM-4914(Vol.2)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR JANUARY–MARCH 1975. II. Heavy-Section Steel Technology Program. Whitman, G. D. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 71p. Dep. NTIS $5.45.

Engineering research activities devoted to extending and developing the technology for assessing the fracture safety of thick-walled steel pressure vessels for light-water-cooled power reactors are reported. Specific areas of research described include: fracture mechanics analyses, effect of high temperature water on subcritical crack growth of steel, properties of irradiated steels, materials and model vessel testing, and thermal shock testing. (HDR)

16565 (ORNL-TM-4944) TOWARD A REGIONAL POWER PLANT SITING METHOD: AEC-MARYLAND REGIONAL SITING FACTORS STUDY, FY 1974 PROGRESS REPORT. Yaffee, S. L.; Miller, C. A. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 112p. Dep. NTIS $8.75.

The "AEC-Maryland Regional Siting Factors Study" examines the process of siting in a regional context. It is developing an analysis method to delineate candidate areas for siting of several power plant technology packages, including both fossil-fueled and nuclear options. Tools that are being used include simulation modeling, economic and demographic forecasting, spatial analysis, and computer graphics and numerical manipulation. The approach will describe the trade-offs incurred if a power plant is located in one candidate area rather than in another. In FY 1974, a suitability analysis method was developed which uses engineering and environmental parameters to define a level of environmental cost incurred if a segment of land is used to site a specific technology package. (auth)

16566 (ORNL-tr-2990) IN-PILE EXPERIMENTS FOR INVESTIGATING FUEL ROD FAILURE. Karb, E. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Nov 1974. Translation by R. G. Mansfield of RBT/1T–1/75. 18p. Dep. NTIS $4.00.

Several in-pile experiments on LWR fuel rod failure during loss-of-coolant accidents are reviewed. The intent of the experiments is to determine the effects of fuel rod failure on ECCS performance. Some planned experiments are also discussed. (JWR)

16567 (PB-240798) COUNTER-FLOW CRITICAL HEAT FLUX RELATED TO REACTOR TRANSIENT ANALYSES. Walkush, J. P.; Griffith, P. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). Jan 1975. 58p. (EPRI-292-2). NTIS $4.25.

For Electric Power Research Inst., Palo Alto, CA.

The experimental results of a program in counter-current critical heat flux are presented. These experiments were performed with Freon 113 at 200 psia in order to model a high pressure water system. An internally heated annulus was used to

model a fuel pin in a channel. Only low flow rates were examined. The flow regime was always bubbly or slug, with the liquid primarily on the walls. It was found that critical heat flux of about 0.9 of the pool boiling value can be expected for up to 20 percent void. Beyond this, the CHF value decreases uniformly with void. Void fractions up to 70 percent were investigated, with the results being slightly below those of a similar experiment carried out at atmospheric pressure by Avedisian. 11 references. (auth)

16568 (PB-242397) ANALYSIS OF GE BWR BLOWDOWN HEAT TRANSFER PROGRAM, TEST 4906 (AEC STANDARD PROBLEM FOUR). Moore, K. V.; Moser, C. M.; Peterson, C. E.; Fernandez, R. T.; Nilsson, K. A. (Energy, Inc., Idaho Falls, Idaho (USA); Electric Power Research Inst., Palo Alto, Calif. (USA)). Jan 1975. 75p. (EPRI-280). NTIS $4.75.

These calculations display the general features expected from a BWR recirculation loop break although several peculiarities are present. First of all, the system pressure initially falls as expected but then increases somewhat prior to the uncovering of the jet pumps. The second unusual feature is that the calculated pin temperatures remain unexpectedly low. The RELAP4 core model used here is incapable of distinguishing the effects of pin locations within the 7 x 7 bundle. Previous TLTA experiments have shown a rather large sensitivity to the bundle location and the power peaking factors of individual pins. Pins with the same peaking factor can have completely different temperature histories; one pin can remain below DNB and relatively cool while another pin heats beyond DNB to rather high temperatures. This degree of detail is not available in the RELAP4 model used here. 5 references. (auth)

16569 (RCN-226) NON-STEADY TWO-PHASE FLOW THROUGH A HEATED TUBE. Lambermont, J. H. M.; Kalker, J. J.; Kalker-Kalkman, C. M. (Stichting Reactor Centrum Nederland, Petten). Jun 1975. 29p. Dep. NTIS (US Sales Only) $4.50.

A method is proposed to treat time dependent fluid flow through a heated tube. The fluid may be liquid in one part of the tube, vapor in another part, and a mixture of liquid and vapor in a third part. No restriction is made regarding the spatial and temporal distribution of the phases in the tube. A semi-quantitative treatment is presented of the phenomena occurring in a liquid-cooled nuclear reactor when inadvertently the coolant temperature increases beyond the boiling point. (auth)

16570 (RD/B/N-3249) PROPAGATION OF THERMAL EXPLOSIONS. Part 2. A Theoretical Model. Board, S. J.; Hall, R. W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Dec 1974. 21p. (CFR/SWP/P-(75)2). Dep. NTIS (US Sales Only) $4.25.

A theoretical model of a propagating fuel/coolant interaction has been developed by applying the classical theory of detonation to the one dimensional case of a plane explosion front propagating through a coarsely mixed region of fuel and coolant. The model suggests that in a suitably large or constrained system thermal explosions can detonate. Predictions of detonation velocities and pressures can be made without a detailed knowledge of the fragmentation and energy transfer processes; these show that for a typical mixture of UO_2, sodium and its vapour, propagation velocities will be ~10^5 cm/sec with pressure ~15 k bar. Energy yields will be slightly greater than those predicted by Hicks and Menzies for constant volume mixing. 12 references. (auth)

16571 (STH-10/74) COMPILATION OF DATA ON ANNUAL RELEASE OF RADIOACTIVE SUBSTANCES IN THE EXHAUST AIR OF NUCLEAR POWER PLANTS AS FROM PLANT COMMISSIONING ONWARDS IN THE FRG, AND FROM 1967 TO 1972 IN THE USA. Haubelt, R. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene). Sep 1974. 20p. (In German). INIS.

12 tabs.

In cooperation with the German Federal Health Office, the operators of nuclear power stations have made available data on the release of radioactive materials in the exhaust air of their nuclear power stations. The annual release data are subdivided as follows: (a) Radioactive gases; (b) Shortlived radioactive aerosols; (c) Longlived radioactive aerosols; (d) Iodine-131 (e) Tritium. U. S. data are indicated for reference. (GE)

16572 (STH-11/74) COMPILATION OF SINGLE NUCLIDE CONCENTRATIONS IN THE OFF-GASES OF THE NUCLEAR POWER PLANTS OF GUNDREMMINGEN, OBRIGHEIM, WUERGASSEN AND STADE USING AEROSOL AND IODINE FILTER SAMPLES. Endrulat, H. J.; Winkelmann, I. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene). Oct 1974. 4p. (In German). INIS.

6 figs.; 26 tabs.

Measured data for the years 1972 and 1973 from single aerosol and iodine filter samples are compiled. For each quarter of a year, off-gas emitted radioactivities of single radionuclides identified in the samples are given. The time-dependent concentration values of ^{131}I in the stack off-gas for a period of 7 days are presented. (GE)

16573 (WANL-TME-1038(Pt.2)) SAFETY EVALUATION REPORT, PART 2. NRX-A3 Reactor Test. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1965. 110p. Dep. NTIS $8.50.

Declassified 11 Sep 1973.

The NRX-A3 test series is planned to extend the area of knowledge obtained from the NRX-A2 test. The primary goal of the NRX-A3 test is to operate at full power for about fifteen minutes followed by a restart to a level as high as full power for a period as long as five minutes. For assessing fission product release, a twenty minute full power run followed, after a week shutdown, by a twenty minute restart to full power has been considered. A summary of NRX-A2 test results which have an influence on safety is presented. Where appropriate, the modifications to the reactor and/or test facility to correct the noted deficiencies are included. Additional changes in the reactor and test facility which result from improved design, or which will be made to increase operational reliability, are described. Key personnel responsible for conduct of the test are listed. The safeguards implemented to minimize occurrence of accidental criticality and occurrence of a malfunction which would lead to abnormal release of fission product inventory are evaluated. Estimates of the fission product source term for normal operation and for potential accidents which are postulated are summarized. The radiological consequences of the test both due to normal operation and potential accidents are reported. (auth)

16574 (WANL-TME-1126) NRX/EST SAFETY EVALUATION REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. 280p. Dep. NTIS $17.00.

Declassified 25 Jun 1975.

The NRX/EST will be the first hot-bleed cycle nuclear rocket engine system test. The NRX/EST Test Assembly consists of the NRX-A4 reactor and a NERVA propellant feed system installed on a basic NRX-A test car with provision to allow conversion to the Test Cell "A" facility propellant feed system for completion of the reactor endurance testing. For the NRX/EST testing in Test Cell "A", the Management Controls specified for the NRX testing have been modified. Changes have also been made in the reactor/test car assembly and in the Test Cell "A" facilities. The design capability and reliability of the major components and hardware involved have been given special attention. The test operations that comprise the NRX/EST program are described and the significance of the radiation levels predicted for normal and abnormal reactor operation are evaluated in terms of the potential nuclear hazard to site and off-site population. Detailed accident analyses of certain system malfunctions are included. System and component malfunction studies have been performed. The predicted radiological hazards from normal operations and/or test failure of NRX/EST are not significantly different from those predicted for the NRX-A3. It is concluded that the NRX/EST operations can be conducted without exposure of personnel either on or off site to excessive radiation levels, provided the tests are conducted under favorable weather conditions. The fission product release to be used as a "source term" in evaluating the potential radiological consequence of the individual experimental plans is developed and these results summarized. (auth)

16575 FRACTURE MECHANICS AND NUCLEAR SAFETY. Bergemann, W.; Theilig, H. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin). Kernenergie: 18: No. 4, 99-104(Apr 1975). (In German).

Efforts in the field of nuclear safety aim at preventing fractures or leaks in the walls of the primary coolant loops of nuclear power plants. One side of those efforts is to study the cracking and fracture process by using computational, experimental, and statistical methods. As to the safety of nuclear power plants it is desirable to obtain results by simultaneously using all of the three above methods. Objective of such studies is to state whether points are present in the primary coolant loop which, in the case of cracking, pertain to the crack type "leak with fracture" or trend towards it. Detected points of this type may preferably be monitored within the scope of in-service inspections in the case of a plant already completed or may be avoided by constructive means in the case of new designs. (auth)

16576 SEEKING SUPER SAFETY. Kaplan, G. IEEE (Inst. Electr. Electron. Eng.). Spectrum.; 12: No. 6, 46-49; 52-55(Jun 1975).

The basic safety philosophy used in the design of nuclear power plants is described in detail. The use of quality assurance and in-service inspection procedures is discussed. (JWR)

16577 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN MARCH AND APRIL 1975. Casto, W. R. Nucl. Saf.: 16: No. 4, 507-511(1975).

Five occurrences reported during March and April 1975 are summarized because of their uniqueness and/or general interest to reactor operations. Relief valves failing to close at two boiling-water reactors (BWRs) in Europe caused suppression-pool damage, and a single tube failure in a steam generator at Point Beach caused a leak rate of 125 gal/min from the primary to the secondary systems. In an event that attracted some publicity, the plant heating system at the Millstone nuclear power station became contaminated. Monticello appears to have solved its problem of explosions in off-gas systems through a number of system-design modifications. The cable fire that occurred at the Browns Ferry nuclear power station will inactivate the plant for several months. (auth)

16578 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Scott, R. L. Nucl. Saf.; 16: No. 4, 496-506(1975).

The information on reactor failures listed came from reports that were abstracted for the Nuclear Safety Information Center at Holifield National Laboratory during March and April 1975. A brief description of each incident is included in the tabulated data, along with the reactor facility (or institution) at which the incident occurred. (auth)

16579 PROBLEMS IN NUCLEAR AIR-CLEANING SYSTEM. Moeller, D. W. Nucl. Saf.; 16: No. 4, 469-481(1975).

A review of published reports of failures in air-cleaning and airborne-waste-management systems at nuclear installations from 1966 to 1974 is presented. The review indicates instances of disruption of noble-gas adsorption systems due to hydrogen explosions; decreased performance of particulate filters due to the presence of contaminants or the failure of seals, dampers, and valves; and improper evaluation of the efficiency of air-cleaning systems due to sampling and other procedural errors. Although a portion of the reported failures can be attributed to manufacturing and design defects, a major share (approximately 65 percent) appears to be due to errors by those responsible for the operation and maintenance of air-cleaning equipment. (auth)

16580 APPLICATION OF EVAPORATION TO THE TREATMENT OF LIQUIDS IN THE NUCLEAR INDUSTRY. Godbee, H. W.; Kibbey, A. H. Nucl. Saf.; 16: No. 4, 458-469(1975).

A survey of evaporation as applied to radioactive-waste solutions showed that system decontamination factors (DFs) of 10^3 to 10^4 can be expected for nonvolatile radioactive contaminants treated in single-stage evaporators. The DFs for iodine can be expected to be a factor of 10 to 100 lower than those expected for nonvolatile species under alkaline, but not oxidizing or acidic, conditions. The DF is reduced by a factor of about 10 if organic materials are mixed with aqueous wastes. These values consider that the evaporator is well designed, adequately sized, and operated with reasonable skill. (auth)

16581 METHOD OF CALCULATING TURBINE MISSILE STRIKE AND DAMAGE PROBABILITIES. Swan, S. W.; Meleist, M. Nucl. Saf.; 16: No. 4, 443-451(1975).

The simple inexpensive computer code described is used for calculating the probability of turbine missile damage to systems required for safe shutdown of a nuclear plant following a structural failure in the turbine-generator system. The code calculates the probability that a turbine missile will strike the concrete structure surrounding a plant system and the probability of damage to the system. Example calculations are presented to illustrate the variation in the calculated probabilities for different arrangements and different target wall thicknesses. (auth)

16582 RELEASE OF RADIOACTIVE NOBLE GASES. Ricardo, F.; Sergio, H.; Gerdingh, L.; Zorrilla, R.; Alejandro Cayetano, F. (Instituto Nacional de Energia Nuclear, Mexico City). Energ. Nucl. (Madrid); 19: No. 93, 31-37(1975). (In Spanish).

The systems used in the General Electric BWR for radioactive waste treatment use as a design base the escape of 2.5 Ci/S of a mixture of noble rare gases before passing through any treatment system. A value K of leaks from the fuel to the coolant, which is independent of the design power, is associated with this escape. However, since the inventory of radioactive gases is dependent on the power, the magnitude of maximum leaks, not to exceed the design value, is calculated as a function of the power. The method followed by General Electric for the calculation of K is outlined and the parameters considered in the present study for the evaluation of K are given. A numerical example of the new calculation of K is made using the Laguna Verde reactor and this value is compared with the General Electric calculations of K. As a result of the calculation of the magnitude of leaks as a function of power, it is concluded that the imperfections in the fuel jackets must be reduced as the power is increased if 2.5 Ci/S is to be maintained as the design base value of a system for gaseous radioactive wastes. (tr-auth)

16583 DECISION-THEORETICAL ANALYSIS FOR THE CHOICE OF SITE OF NUCLEAR POWER PLANTS. Avenhaus, R.; Gros, J. (Internationales Inst. fuer Angewandte Systemanalyse, Laxenburg (Austria)). Atomwirtsch., Atomtech.; 20: No. 1, 29-31(Jan 1975). (In German).

A short description is given of the formalism in decision theory which involves the following steps: (1) identification of interested parties and of criteria ("attributes") which are important for a decision, such as cooling water discharge temperatures, etc.; (2) estimate of the preferential functions of the attributes; (3) determination of technical relations; (4) solution of the optimization problem. On the basis of nuclear power plant sites in New England as a specific example the analytical method and the conclusions that can be drawn from the optimum solutions are demonstrated. Finally, the applicability of the method to problems of forecasting sites to be selected in the near future and to problems arising in connection with conditions imposed in specific cases is discussed. (GE)

16584 CRITICAL POINTS. Umwelt.; No. 6, 11-14(Dec 1974). (In German).

Excerpts from a report of the Bundesinnenministerium responsible for reactor safety and radiation protection are presented. It is concluded that the safety system for the handling of radioactive materials in the FRG is actually intact and adequate, but there are a few "critical points". (GE)

16585 POWER PLANT SITES. Kuhlmann, A. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (F. R. Germany)). Tech. Ueberwach.; 16: No. 2, 31-37(Feb 1975). (In German).

From lecture meeting on energy and environment; Duesseldorf, F. R. Germany (5 Dec 1974).

The site selection for conventional and nuclear power plants is discussed with respect to hypothetical accidents and their occurrence probability. (GE)

16586 NUCLEAR ENERGY SAFETY. Gruhier, F. Sci. Avenir; No. 337, 243-254, 259-261(Mar 1975). (In French).

Consideration is given to the risks linked to nuclear energy: risks of accidents in power stations (Rasmussen report); irradiation from power stations; waste processing; thermal pollution; plutonium; the promises and risks of breeders. It is shown how expert opinions differ and how the public at large finds it difficult to form an unbiased opinion. (FR)

16587 NUCLEAR SITING IN FRANCE: GENERAL SAFETY AND PROTECTION PRINCIPLES AND RESULTS FROM RECENT STUDIES. Candes, P. (Ministere de l'Industrie et de la Recherche, 75 – Paris (France). Service Central de Surete des Installations Nucleaires); Coulon, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection); Doury, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Surete Nucleaire). pp 169-171 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The site studies describe: the impact of the nuclear plant on its environment (long-range atmospheric diffusion, interaction of various radioactive pollutants, determination of limits, criterion for an objective assessment of the site) and the stress that the environment may exert on the plant (effect of industrial environment, geological and seismological conditions). (FR)

16588 INFLUENCE OF OPERATING PROBLEMS ON NUCLEAR PLANT DESIGN. Lhuillery, A. (Electricite de France, 92 – Courbevoie. Service Etudes et Projets Thermiques et Nucleaires). pp 167-168 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The incidence of operating problems on the design of a nuclear power station acquires a new dimension for nuclear energy plants due to ionizing radiations. It appears to be indispensable, but fortunately possible, to reduce the absorbed doses in operation; the contribution of all concerned (industrial architect, operator, ...) are necessary. (FR)

16589 SEEKING LARGE POWER NUCLEAR SITES IN TERMS OF THE IMPACT THERMAL DISCHARGES ON THE ENVIRONMENT. Daubert, A.; Jacquet, J.; Lebreton, J. C. (Electricite de France, 75 – Paris. Dept. Etudes Generales Programmes-Sites Environnement). pp 168-169 of La maturite de l'energie

nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The protection of the environment leads to seek the sites with a high dilution power in the atmosphere and in the hydrosphere. Only the problems of thermal effluents are considered. The following topics are discussed: different location strategies in France; impact of atmospheric thermal discharges and classification of sites in terms of their capacity for dispersing thermal discharges; impact of thermal discharges into the marine environment; comparison of sites according to the cooling system adopted. (FR)

16590 SOME PROBLEMS RAISED BY THE LAW OF NUCLEAR LIABILITY. Deprimoz, Jacques (Pool Francais d'Assurances des Risques Atomiques, 75 – Paris). Rev. Gen. Assur. Terr.; 45: No. 2, 169-187(Apr 1974). (In French).

The fundamentals of the law of nuclear liability as stated in the Paris Convention are reviewed and a number of problems are examined, viz. causality principle, time limitation, extent of damage giving right to compensation, liability for damage to on-site property. (FR)

16591 NUCLEAR POWER PLANT RELIABILITY. Haueter, R. L. (Consumers Power Co., Jackson, MI). Proc. Am. Power Conf.; 36: 200-209(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Information is presented concerning the recording and reporting procedures for all reactor component failures to a nuclear plant reliability data system. (DCC)

16592 DEVELOPING ENVIRONMENTAL TECHNICAL SPECIFICATIONS FOR NUCLEAR POWER PLANTS: RECENT EXPERIENCE. Firth, R. W. Jr.; Glynn, R. D. Jr. (Woodward-Clyde Consultants, Clifton, NJ). Proc. Am. Power Conf.; 36: 215-218(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

16593 PREOPERATIONAL ENVIRONMENTAL RADIOACTIVITY SURVEILLANCE PROGRAM FOR THE FIRST NUCLEAR POWER PLANT IN TAIWAN. Weng, P. S. (National Tsing-Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 1, 1-11(Mar 1975).

The preoperational environmental radioactivity surveillance program for the first nuclear power plant in Taiwan was derived from the U. S. Environmental Radioactivity Surveillance Guide, the recommendations of the World Health Organization, and Taiwan experiences. Both the natural radioactivity and the artificial radioactivity were equally emphasized and surveyed. Some methods were developed to meet the requirements unique in Taiwan particularly due to the semitropical weather. Quality control has been performed for some radionuclide analysis with other laboratories in foreign countries. An on-the-job training program was initiated at the same time the surveillance program was started to expand and reserve manpower for environmental monitoring for nuclear power stations. The results of survey data were compared with similar nuclear power stations which are in operation in the United States. Experiences on technical aspects of this surveillance program are included and discussed. (auth)

16594 DUTIES OF INFORMATIONAL ACTIVITY AT THE DECISIVE PHASE FOR NUCLEAR POWER PLANTS. Botta, G. Ing. Nucl.; 15: 7-10(1974). (In Italian).

Energy generation and environmental problems are closely intertwined; it is impossible to study the first without taking the second into consideration. Social, economic, industrial and even political factors are involved in the local antagonism toward the construction of nuclear plants. The Italian experience is compared with that gained in Great Britain, France and Switzerland; in the two latter countries, an actual "psychosis" developed in the people living near the construction sites. The system of "public hearings" and the controversy that they engendered in the United States are also reviewed. Considerable intolerance was encountered in Japan, as shown by the "Mutsu" incident. Public enlightenment is needed to resolve the misunderstanding. Although the general population obtains its information primarily through the daily and weekly papers and TV, there is a great lack of competent science writers. There is need to create a regional organization to serve as a medium of communication between citizens, institutions and the local government on this subject. (TTT)

16595 SITING PROBLEMS OF NUCLEAR POWER PLANTS AT THE SEACOAST. Antonelli, A.; Belli, A.; Brondi, A. (CNEN, Rome). Ing. Nucl.; 15: 11-14(1974). (In Italian).

In order to protect the Italian seacoast, a zoning system was initiated, subdividing the shoreline into residential, industrial, recreational and tourist areas for long-range use. Any activity that requires large amounts of cooling water must prove that it is compatible with neighboring activities. This includes chemical, petrochemical and metallurgical plants, and conventional and nuclear power stations. Although the Italian coast is 7458 km long, it is difficult to find suitable locations for nuclear plants because about 55% of this is steep and rocky. Geological problems, especially the potential contamination of the aquifer must be carefully examined. The current regulations seem to favor siting nuclear plants in agricultural zones or near greenbelt areas. (TTT)

16596 ISO/85 STANDARDS COMMITTEE WORKING IN THE FIELD OF NUCLEAR ENERGY AND IONIZING RADIATIONS. Ing. Nucl.; 15: 21-23(1974). (In Italian).

The International Standardization Organization which includes among its members the standard-setting agencies of 90 countries and carries out its activities through about 130 technical committees, designated Committee TC/85 as being responsible for proposing and issuing standards for the industrial applications of nuclear energy and of radioisotopes. The committee includes representatives of 22 industrial countries. During the 1969 to 1973 period the committee carried out its work through the following 4 subcommittees: SC/1 terminology and symbols; SC/2 radiation protection; SC/3 reactor safety and SC/4 radioisotopes. Differences between the laws and regulations of the United States and the European countries presented difficulties in the promulgation of uniform international standards. In 1974, ANSI which acts as the secretariat for ISO/85 renamed SC/3 as the Power Reactor Technology subcommittee and proposed the creation of SC/5 Nuclear Fuel Technology, and SC/6 Industrial Use of Radiations. The status of drafts and issued standards is listed. Several other international organizations, such as IAEA, the International Electrotechnical Commission, the European Standardization Organization, Euratom and OECD also have committees working in this area. (TTT)

16597 LABORATORY TESTS FOR CLASSIFYING HIGH- AND VERY-HIGH-EFFICIENCY PARTICLE FILTERS. Ing. Nucl.; 15: 24-34(1974). (In Italian).

The draft of the Italian standard for particle filters, prepared by the G2 "Filters" Work Group of the Italian Committee for the separation of airborne particles is reviewed. The purpose of the standard is to establish the criteria for classifying the filters into high-efficiency and very-high-efficiency groups. The appendix to the standard contains instructions for testing the efficiency in the laboratory on the basis of the DOP method (ANSI N 101.1. 1972 "Efficiency Testing of Air Cleaning Systems, Containing Devices for the Removal of Particles"); the condensation of nuclei, or the Polak method, and the uranine method, based on the French standard NFX 44-011 May 1972. (TTT)

16598 ENVIRONMENTAL EFFECTS OF NUCLEAR POWER PLANTS. Santarelli, E. Ing. Nucl.; 15: 4-6(1974). (In Italian).

The Italian Nuclear Engineering Society is organizing a series of conferences on environmental effects due to the operation of nuclear power plants. Aspects of the problem, of interest to the general public and to non-nuclear government agencies are summarized. During the Sixties when the first 3 Italian nuclear plants were under construction, the public had not yet become sensitized to these problems. The situation changed radically: at present, plans for both conventional and nuclear power plants are closely scrutinized to ascertain the level of atmospheric pollution and heat released to the environment. It is emphasized that reactor operations do not necessarily release radioactivity into the atmosphere. Both normal and emergency operations are considered. The released heat changes markedly the properties of water used for cooling, including density, vapor pressure, solubility of dissolved oxygen, etc. However, the designers have taken these factors into account. The scheduled conferences will make this information widely available. (TTT)

Reactor Theory and Calculation

Refer also to abstract 15772.

16599 (DP-MS-75-4) BENCHMARK U–D_2O EXPERIMENTS AND COMPARISON WITH COMPUTATIONS. Pellarin, D. J.; Morris, B. M. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 31p. (CONF-750624-8). Dep. NTIS $4.75.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Material bucklings and reaction rate parameters were measured for heavy water (D_2O) moderated, uniform lattices in the exponential facility (SE-SP) at the Savannah River Laboratory (SRL).

Two different slightly enriched, coaxial, uranium fuel assemblies were examined over a wide range of triangular lattice pitches in this study. Results of experiments were compared with RAHAB computations using ENDF/B-IV cross sections. (auth)

16600 (DP-MS-75-59) DEPLETION BENCHMARK IN HEX-Z GEOMETRY. Gregory, M. V. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 45p. (CONF-750607-18). Dep. NTIS $5.25.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A tripartite depletion benchmark problem has been defined. The first part is a point depletion benchmark which tests the method used to solve the isotopic depletion equations, independent of reactor geometry. The second part tests the method used to generate burnup-dependent, few group cross sections in a hexagonal lattice depletion calculation. The final part tests the depletion calculation for the reactor in hex-z geometry. Several solutions of the reactor depletion benchmark are discussed both to evaluate the effect of various simplifications in describing the benchmark reactor and to permit a range of benchmark solutions to be meaningfully compared. The three parts of the benchmark problem are defined independently of one another. (auth)

16601 (EURFNR-1225) DETERMINATION OF THE TURBULENT VELOCITY AND TEMPERATURE FIELD IN ROD BUNDLES USING CURVILINEAR ORTHOGONAL COORDINATES. Meyder, R. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Sep 1974. Translation of KFK-2029. 81p. Dep. NTIS $7.25.

Work performed under United States–Euratom fast reactor exchange program.

The momentum and heat transfer equations for the central coolant channel of a reactor subassembly are solved for the first time in general curvilinear orthogonal co-ordinates. The coordinates were specially determined for the subchannel. The method is explained using the example of laminar flow. For turbulent flow, the eddy-diffusivities are determined by the "mixing-length" hypothesis of Prandtl. A new method is proposed to determine anisotropic eddy-diffusivities. The eddy-diffusivities of heat are calculated from the eddy-diffusivities of momentum using the relations obtained by various authors and the results are compared in the case of sodium. To show the capability of the developed computer-codes the three dimensional temperature field is calculated in the central subchannel of a fuel element cooled by sodium, helium and pressurized water. The agreement between calculated results and experiments is very satisfactory down to a P/D ratio of 1.15. (auth)

16602 (FEI-448) HEAT TRANSFER IN TURBULENT FLOW OF VARIOUS COOLANTS IN THE CHANNELS OF THE TRIANGULAR LATTICE OF CYLINDRICAL FUEL ELEMENTS. Bobkov, V. P.; Ibragimov, M. Kh.; Savanin, N. K.; Sinyavskij, V. F. (Gosudarstvennyj Komitet po ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 41p. (In Russian). INIS.

Based on calculations of temperature fields by methods developed by the authors and an analysis of experimental heat exchange data with turbulent stabilized flow of different heat exchangers in triangular infinite beams of cylindrical rods, approximate generalized dependences for Nu numbers and temperature nonequilibriums of the walls were obtained in a universal form in the following ranges of parameters: relative step of placement of rods in the lattice, s/d_0, from 1 to 2; Re number from 10^4 to 10^5; Pr number from 0 to 10; and parameter of approximate heat modeling, ϵ_{t0}, from 0.01 to 100. (tr-auth)

16603 (KFKI-75-27) INVESTIGATION OF THE LOCAL COMPONENT OF POWER-REACTOR NOISE VIA DIFFUSION THEORY. Kosaly, G. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 41p. Dep. NTIS (US Sales Only) $5.25.

In recent years several experimental workers succeeded in measuring steam velocity in a BWR by correlating the signals of axially placed incore neutron detectors. This success indicates that the field of neutron noise contains a strong component which is driven by local disturbances. The existence of such a local term was one of the main assumptions of a recent phenomenological theory of the noise field in a BWR core. The theoretical background of the phenomenological theory is given by solving the two-group diffusion equations satisfied by the neutron noise driven by a propagating disturbance of moderator density. One of the terms in the solution is identified as the local term, and its characteristic features and its ratio to other terms are discussed. 20 references. (auth)

16604 GENERALIZED CONTINUOUS NEUTRON SLOWING-DOWN THEORY. Kamei, T. (Argonne National Lab., IL). Nucl. Sci. Eng.; 57: No. 3, 179-187(Jul 1975).

Continuous slowing-down theory is generalized so that inelastic scattering can be accurately taken into account. The basic idea underlying generalized theory is the assumption that the ratio, R(u), of the solution spectrum to a reference spectrum, g(u), varies linearly with the lethargy, u; that is, R(u) can be approximated by two terms of a Taylor series as long as g(u) is chosen reasonably. Such conventional theories as Geortzel-Greuling (GG) or Stacey's improved-GG are included in this theory by taking g(u) as 1/SIGMA/sub s,l/(u) or 1/SIGMA/sub t/(u), respectively. The present theory is demonstrated to yield quite accurate results for the neutron spectra and coarse-group effective cross sections in many varieties of core and blanket compositions of fast reactors, using three alternative prescriptions for g(u). (auth)

16605 ENERGY-DEPENDENT APPLICATIONS OF THE TRANSFER MATRIX METHOD. Oeztunali, O. I. (Dames and Moore, White Plains, NY); Aronson, R. Nucl. Sci. Eng.; 57: No. 3, 196-204(Jul 1975).

The transfer matrix method is applied to energy-dependent neutron transport problems for multiplying and nonmultiplying media in one-dimensional plane geometry. Experimental cross sections are used for total, elastic, and inelastic scattering and fission. Numerical solutions are presented for the problem of a unit point isotropic source in an infinite medium of water and for the problem of the critical ^{235}U slab with finite water reflectors. No iterations were necessary in this method. Numerical results obtained are consistent with physical considerations and compare favorably with the moments method results for the problem of the unit point isotropic source in an infinite water medium. (auth)

16606 EXACT CALCULATIONS OF FIRST MOMENT IN A SIMPLE NEUTRONIC SYSTEM. Karmeshu; Bansal, N. K. (Univ. of Delhi). Nucl. Sci. Eng.; 57: No. 3, 245-247(Jul 1975).

The average neutron density and the average delayed-neutron precursor density for a neutron-multiplying system have been calculated assuming the reactivity to be a two-valued Markov process. The resulting values are shown to be stable for asymptotically long times in agreement with the conclusions of Williams. (auth)

16607 ANALYSIS OF SELECTED FAST CRITICAL ASSEMBLIES USING ENDF/B-IV NEUTRON CROSS SECTIONS. Hardie, R. W.; Schenter, R. E.; Wilson, R. E. (Westinghouse Hanford Co., Richland, WA). Nucl. Sci. Eng.; 57: No. 3, 222-238(Jul 1975).

Measured integral quantities such as k/sub eff/, central reaction-rate ratios, and central reactivity coefficients for 18 fast critical assemblies were calculated using the ENDF/B-IV neutron cross-section set. The correlations between calculation and experiment using Version IV were then compared to those obtained with earlier cross-section data, specifically, Versions I, II, and III of ENDF/B and the Bondarenko cross-section set. In general, ENDF/B-IV was found to do an excellent job of calculating k/sub eff/. However, discrepancies between calculation and experiment did exist for both reaction-rate ratios and reactivity coefficients. Of particular interest, the fissile-fuel central-worth discrepancy for plutonium assemblies was found to be approximately 20 percent. (auth)

16608 SOLVING THE CONSERVATION EQUATIONS IN FUEL ROD BUNDLES EXPOSED TO PARALLEL FLOW BY MEANS OF CURVILINEAR-ORTHOGONAL COORDINATES. Meyder, R. (Gasellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). J. Comput. Phys.; 17: No. 1, 53-67(Jan 1975).

A method is described for constructing a curvilinear–orthogonal mesh grid. A method to perform calculations in such mesh grid is also illustrated. The method is demonstrated for the problem of laminar flow ir rod bundle geometry. The comparison of the results with those of other authors is good. (auth)

Reactor Components and Accessories

Refer also to abstracts 14157, 14401, and 16663.

16609 (EP-74-R-34, pp 30-51) IN-SERVICE PROBLEMS RELATED TO STRESS ANALYSIS IN NUCLEAR POWER PLANTS. Panesar, J. S. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

There are a number of stress analysis problems that arise after a component has been installed and is in service. Some of these problems and their possible solutions, in light of the specifications, the governing ASME codes, and the jurisdictional authorities, are discussed. Some typical problems that may arise from inservice inspection findings, very high performance standards expected in nuclear applications, changes in the oper-

ating conditions, and the lack of accurate and complete material properties during the design stages of the components are considered. (auth)

16610 (EP-74-R-34, pp 52-68) R AND D BEYOND THE PRESSURE VESSEL CODE. Baldur, R. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

Research aimed at updating the Pressure Vessel Code is briefly described. Problems are outlined in the computation of stresses in thick walled vessels, interpretation of fatigue requirements, and calculating tubesheet stresses. Computer programs are being modified to provide models which behave increasingly like the real physical structures. (CA)

16611 (EP-74-R-34, pp 69-82) LIMIT ANALYSIS IN PRESSURE VESSEL APPLICATIONS. Biron, A. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

Major features of limit analysis are described and some typical results, obtained through computer programs developed at the Ecole Polytechnique, are given which are applicable to pressure vessel configurations. (CA)

16612 (EP-74-R-34, pp 83-92) EXPERIMENTAL STRESS ANALYSIS OF PRESSURE VESSEL COMPONENTS. Bazergui, A. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

The experimental stress analysis procedure is presented which has been developed and used extensively at the Applied Mechanics Laboratories of Ecole Polytechnique for the study of models of pressure vessels and machine components. The procedure consists in using epoxy resin as the model material. When required, a preliminary analysis is carried out using brittle lacquers in order to locate the regions of interest. The model is instrumented with surface strain gages and, when required, temperature sensors or thermocouples. Strain gages and temperature sensors may also be embedded within the wall of the models for the determination of the state of strain at internal points. (auth)

16613 (EP-74-R-34, pp 93-103) THERMAL EFFECTS ON TUBESHEETS. Dubuc, J. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada). Dept. de Genie Metallurgique).

An experimental investigation is described which relates to non-symmetric problems in the stress analysis of nuclear power plant components, with particular emphasis on heat exchangers. (auth)

16614 (EP-74-R-34, pp 104-113) STRESSES DUE TO SUPPORT REACTIONS. Dore, R. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

A research program is described which aims to predict the contact pressure between vessels and supports and to obtain the resulting deformations and stresses; to design optimum supports such that the maximum value of the local membrane and the local total stresses are minimized. (auth)

16615 (EP-74-R-34, pp 114-115) CORNER RADIUS AND HUB LENGTH NEAR WELDS. Laberge, C. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

The present work investigates the stress distribution in a pressure part with hub having a thickness t_f equal to the shell thickness t_s. A hypothetical problem is used with a plate of constant thickness subjected to a unit pressure. For each shell thickness having several fillet radii the peak stress intensity at the inner surface is given. (auth)

16616 (ISD-151) RECENT DEVELOPMENTS IN THE FINITE ELEMENT ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS. Argyris, J. H.; Faust, G.; Szimmat, J.; Warnke, E. P.; Willam, K. J. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Statik und Dynamik der Luft-und Raumfahrtkonstruktionen). 1973. 46p. INIS.

33 figs.; 64 refs. Published in Int. J. Nucl. Eng. Design, v. 27 (1974).

Recent developments in finite element analysis of nonlinear deformation and ultimate load of prestressed concrete reactor vessels are described. First a number of finite element models are called into attention for the idealization of composite structures such as reinforced and prestressed concrete components. Then different inelastic constitutive models are proposed for the behavior of concrete in the pre- and post-failure regime. Various numerical techniques are examined for the solution of nonlinear problems, especially with regard to their distortion of the constitutive model. These modeling techniques are applied to the analysis of four typical examples, the nonlinear deformation analysis of a concrete specimen subjected to biaxial compression, the crack analysis of a thick walled concrete cylinder, the overload analysis of the THTR 1:5 scale model and the ultimate load analysis of a concrete top closure model. (auth)

16617 (LA-5989-MS) GRAVITY-ASSIST HEAT PIPES FOR THERMAL CONTROL SYSTEMS. Deverall, J. E.; Keddy, E. S.; Kemme, J. E.; Phillips, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 15p. Dep. NTIS $4.00.

Sodium heat pipes, operating in the gravity-assist mode, have been incorporated into irradiation capsules to provide a means for establishing and controlling a desired specimen temperature. Investigations were made of new wick structures for potassium heat pipes to operate at lower temperatures and higher heat transfer rates, and a helical trough wick structure was developed with an improved heat transfer capability in the temperature range of interest. Test results of these heat pipes led to the study of a new heat pipe limit which had not previously been considered. (12 references) (auth)

16618 (ORNL-SUB-3131-11) EXPLORATORY STUDY OF THE FEASIBILITY OF DEVELOPING STRESS INDICES FOR THERMAL GRADIENTS IN PRESSURE VESSEL NOZZLES. Phase Report 117-11. Rodabaugh, E. C. (Battelle Columbus Labs., Ohio (USA)). 12 May 1975. 76p. Dep. NTIS $7.00.

For Oak Ridge National Lab., TN.

The report includes calculated stresses, in the form of stress indices, for 8 "models" of nozzles in spherical shells, with three types of temperature gradients, (1) step axial gradient, (2) linear thru-wall gradient, and (3) linear axial gradient. Calculations were made with a shell-type analysis and, for one of the models, a calculation was also made using a finite-element analysis. In addition, the results are presented of an exploratory investigation into the feasibility of obtaining stresses at nozzles in pressure vessels directly and simply from the specified fluid temperature transient, thereby eliminating the costly and time-consuming heat transfer analysis as well as the detailed thermal stress analysis. (4 references) (auth)

16619 DESIGN OF PRESSURE VESSELS FOR ELEVATED TEMPERATURE SERVICE. Berman, I. J. Pressure Vessel Technol.; 96: No. 1, 2-8(Feb 1974).

Design of high reliability nuclear components for use at elevated temperature is considered. The design is related to the design of structures at lower temperature and structures with lesser reliability requirements. The application of design by analysis is considered in some detail. It is concluded that procedures in addition to design by analysis are required for reliable results at elevated temperature. Some approaches are suggested. (Metals Abstr.)

16620 BUTTERFLY VALVES: GREATER USE IN POWER PLANTS. McCoy, M. Power Eng.; 79: No. 7, 56-59(Jul 1975).

Improvements in butterfly valves, particularly in the areas of automatic control and leak tightness are described. The use of butterfly valves in nuclear power plants is discussed. These uses include service in component cooling, containment cooling, and containment isolation. The outlook for further improvements and greater uses is examined. (JWR)

16621 PROCESS FOR WITHDRAWING RADIOACTIVE GASES FROM A NUCLEAR REACTOR. Frumerman, R.; Brown, W. W. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,209,177/A/. 16 Oct 1973. 7p. (In French).

The coolant is evacuated to a reduced level in order to provide a supplementary gas space which is then filled with an inert gas. The coolant is circulated continuously in order to facilitate the release of the radioactive gas from the coolant to the inert gas, which is then evacuated with the radioactive gases and stored in aging tanks. This procedure permits a rapid reduction of radioactive gases in coolants. (tr-FR)

16622 NEW TECHNIQUES FOR INSPECTION AND MAINTENANCE OF REACTORS. Vertut, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service

Two different slightly enriched, coaxial, uranium fuel assemblies were examined over a wide range of triangular lattice pitches in this study. Results of experiments were compared with RAHAB computations using ENDF/B-IV cross sections. (auth)

16600 (DP-MS-75-59) DEPLETION BENCHMARK IN HEX-Z GEOMETRY. Gregory, M. V. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 45p. (CONF-750607-18). Dep. NTIS $5.25.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A tripartite depletion benchmark problem has been defined. The first part is a point depletion benchmark which tests the method used to solve the isotopic depletion equations, independent of reactor geometry. The second part tests the method used to generate burnup-dependent, few group cross sections in a hexagonal lattice depletion calculation. The final part tests the depletion calculation for the reactor in hex-z geometry. Several solutions of the reactor depletion benchmark are discussed both to evaluate the effect of various simplifications in describing the benchmark reactor and to permit a range of benchmark solutions to be meaningfully compared. The three parts of the benchmark problem are defined independently of one another. (auth)

16601 (EURFNR-1225) DETERMINATION OF THE TURBULENT VELOCITY AND TEMPERATURE FIELD IN ROD BUNDLES USING CURVILINEAR ORTHOGONAL COORDINATES. Meyder, R. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Sep 1974. Translation of KFK-2029. 81p. Dep. NTIS $7.25.

Work performed under United States–Euratom fast reactor exchange program.

The momentum and heat transfer equations for the central coolant channel of a reactor subassembly are solved for the first time in general curvilinear orthogonal co-ordinates. The coordinates were specially determined for the subchannel. The method is explained using the example of laminar flow. For turbulent flow, the eddy-diffusivities are determined by the "mixing-length" hypothesis of Prandtl. A new method is proposed to determine anisotropic eddy-diffusivities. The eddy-diffusivities of heat are calculated from the eddy-diffusivities of momentum using the relations obtained by various authors and the results are compared in the case of sodium. To show the capability of the developed computer-codes the three dimensional temperature field is calculated in the central subchannel of a fuel element cooled by sodium, helium and pressurized water. The agreement between calculated results and experiments is very satisfactory down to a P/D ratio of 1.15. (auth)

16602 (FEI-448) HEAT TRANSFER IN TURBULENT FLOW OF VARIOUS COOLANTS IN THE CHANNELS OF THE TRIANGULAR LATTICE OF CYLINDRICAL FUEL ELEMENTS. Bobkov, V. P.; Ibragimov, M. Kh.; Savanin, N. K.; Sinyavskij, V. F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 41p. (In Russian). INIS.

Based on calculations of temperature fields by methods developed by the authors and an analysis of experimental heat exchange data with turbulent stabilized flow of different heat exchangers in triangular infinite beams of cylindrical rods, approximate generalized dependences for Nu numbers and temperature nonequilibriums of the walls were obtained in a universal form in the following ranges of parameters: relative step of placement of rods in the lattice, s/d_0, from 1 to 2; Re number from 10^4 to 10^5; Pr number from 0 to 10; and parameter of approximate heat modeling, $\epsilon_{k\theta}$, from 0.01 to 100. (tr-auth)

16603 (KFKI-75-27) INVESTIGATION OF THE LOCAL COMPONENT OF POWER-REACTOR NOISE VIA DIFFUSION THEORY. Kosaly, G. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 41p. Dep. NTIS (US Sales Only) $5.25.

In recent years several experimental workers succeeded in measuring steam velocity in a BWR by correlating the signals of axially placed incore neutron detectors. This success indicates that the field of neutron noise contains a strong component which is driven by local disturbances. The existence of such a local term was one of the main assumptions of a recent phenomenological theory of the noise field in a BWR core. The theoretical background of the phenomenological theory is given by solving the two-group diffusion equations satisfied by the neutron noise driven by a propagating disturbance of moderator density. One of the terms in the solution is identified as the local term, and its characteristic features and its ratio to other terms are discussed. 20 references. (auth)

16604 GENERALIZED CONTINUOUS NEUTRON SLOWING-DOWN THEORY. Kamei, T. (Argonne National Lab., IL). Nucl. Sci. Eng.; 57: No. 3, 179-187(Jul 1975).

Continuous slowing-down theory is generalized so that inelastic scattering can be accurately taken into account. The basic idea underlying generalized theory is the assumption that the ratio, R(u), of the solution spectrum to a reference spectrum, g(u), varies linearly with the lethargy, u; that is, R(u) can be approximated by two terms of a Taylor series as long as g(u) is chosen reasonably. Such conventional theories as Geortzel-Greuling (GG) or Stacey's improved-GG are included in this theory by taking g(u) as 1/SIGMA/sub s,i/(u) or 1/SIGMA/sub t/(u), respectively. The present theory is demonstrated to yield quite accurate results for the neutron spectra and coarse-group effective cross sections in many varieties of core and blanket compositions of fast reactors, using three alternative prescriptions for g(u). (auth)

16605 ENERGY-DEPENDENT APPLICATIONS OF THE TRANSFER MATRIX METHOD. Oeztunali, O. I. (Dames and Moore, White Plains, NY); Aronson, R. Nucl. Sci. Eng.; 57: No. 3, 196-204(Jul 1975).

The transfer matrix method is applied to energy-dependent neutron transport problems for multiplying and nonmultiplying media in one-dimensional plane geometry. Experimental cross sections are used for total, elastic, and inelastic scattering and fission. Numerical solutions are presented for the problem of a unit point isotropic source in an infinite medium of water and for the problem of the critical ^{235}U slab with finite water reflectors. No iterations were necessary in this method. Numerical results obtained are consistent with physical considerations and compare favorably with the moments method results for the problem of the unit point isotropic source in an infinite water medium. (auth)

16606 EXACT CALCULATIONS OF FIRST MOMENT IN A SIMPLE NEUTRONIC SYSTEM. Karmeshu; Bansal, N. K. (Univ. of Delhi). Nucl. Sci. Eng.; 57: No. 3, 245-247(Jul 1975).

The average neutron density and the average delayed-neutron precursor density for a neutron-multiplying system have been calculated assuming the reactivity to be a two-valued Markov process. The resulting values are shown to be stable for asymptotically long times in agreement with the conclusions of Williams. (auth)

16607 ANALYSIS OF SELECTED FAST CRITICAL ASSEMBLIES USING ENDF/B-IV NEUTRON CROSS SECTIONS. Hardie, R. W.; Schenter, R. E.; Wilson, R. E. (Westinghouse Hanford Co., Richland, WA). Nucl. Sci. Eng.; 57: No. 3, 222-238(Jul 1975).

Measured integral quantities such as k/sub eff/, central reaction-rate ratios, and central reactivity coefficients for 18 fast critical assemblies were calculated using the ENDF/B-IV neutron cross-section set. The correlations between calculation and experiment using Version IV were then compared to those obtained with earlier cross-section data, specifically, Versions I, II, and III of ENDF/B and the Bondarenko cross-section set. In general, ENDF/B-IV was found to do an excellent job of calculating k/sub eff/. However, discrepancies between calculation and experiment did exist for both reaction-rate ratios and reactivity coefficients. Of particular interest, the fissile-fuel central-worth discrepancy for plutonium assemblies was found to be approximately 20 percent. (auth)

16608 SOLVING THE CONSERVATION EQUATIONS IN FUEL ROD BUNDLES EXPOSED TO PARALLEL FLOW BY MEANS OF CURVILINEAR-ORTHOGONAL COORDINATES. Meyder, R. (Gasellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). J. Comput. Phys.; 17: No. 1, 53-67(Jan 1975).

A method is described for constructing a curvilinear–orthogonal mesh grid. A method to perform calculations in such mesh grid is also illustrated. The method is demonstrated for the problem of laminar flow ir rod bundle geometry. The comparison of the results with those of other authors is good. (auth)

Reactor Components and Accessories

Refer also to abstracts 14157, 14401, and 16663.

16609 (EP-74-R-34, pp 30-51) IN-SERVICE PROBLEMS RELATED TO STRESS ANALYSIS IN NUCLEAR POWER PLANTS. Panesar, J. S. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

There are a number of stress analysis problems that arise after a component has been installed and is in service. Some of these problems and their possible solutions, in light of the specifications, the governing ASME codes, and the jurisdictional authorities, are discussed. Some typical problems that may arise from inservice inspection findings, very high performance standards expected in nuclear applications, changes in the oper-

ating conditions, and the lack of accurate and complete material properties during the design stages of the components are considered. (auth)

16610 (EP-74-R-34, pp 52-68) R AND D BEYOND THE PRESSURE VESSEL CODE. Baldur, R. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

Research aimed at updating the Pressure Vessel Code is briefly described. Problems are outlined in the computation of stresses in thick walled vessels, interpretation of fatigue requirements, and calculating tubesheet stresses. Computer programs are being modified to provide models which behave increasingly like the real physical structures. (CA)

16611 (EP-74-R-34, pp 69-82) LIMIT ANALYSIS IN PRESSURE VESSEL APPLICATIONS. Biron, A. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

Major features of limit analysis are described and some typical results, obtained through computer programs developed at the Ecole Polytechnique, are given which are applicable to pressure vessel configurations. (CA)

16612 (EP-74-R-34, pp 83-92) EXPERIMENTAL STRESS ANALYSIS OF PRESSURE VESSEL COMPONENTS. Bazergui, A. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

The experimental stress analysis procedure is presented which has been developed and used extensively at the Applied Mechanics Laboratories of Ecole Polytechnique for the study of models of pressure vessels and machine components. The procedure consists in using epoxy resin as the model material. When required, a preliminary analysis is carried out using brittle lacquers in order to locate the regions of interest. The model is instrumented with surface strain gages and, when required, temperature sensors or thermocouples. Strain gages and temperature sensors may also be embedded within the wall of the models for the determination of the state of strain at internal points. (auth)

16613 (EP-74-R-34, pp 93-103) THERMAL EFFECTS ON TUBESHEETS. Dubuc, J. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada). Dept. de Genie Metallurgique).

An experimental investigation is described which relates to non-symmetric problems in the stress analysis of nuclear power plant components, with particular emphasis on heat exchangers. (auth)

16614 (EP-74-R-34, pp 104-113) STRESSES DUE TO SUPPORT REACTIONS. Dore, R. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

A research program is described which aims to predict the contact pressure between vessels and supports and to obtain the resulting deformations and stresses; to design optimum supports such that the maximum value of the local membrane and the local total stresses are minimized. (auth)

16615 (EP-74-R-34, pp 114-115) CORNER RADIUS AND HUB LENGTH NEAR WELDS. Laberge, C. Jul 1974.

From proceedings of seminar stress analysis of nuclear power plant components; Montreal, Canada (2 May 1974).

In stress analysis of nuclear power plant components. (Ecole Polytechnique, Montreal, Quebec (Canada)).

The present work investigates the stress distribution in a pressure part with hub having a thickness t_f equal to the shell thickness t_s. A hypothetical problem is used with a plate of constant thickness subjected to a unit pressure. For each shell thickness having several fillet radii the peak stress intensity at the inner surface is given. (auth)

16616 (ISD-151) RECENT DEVELOPMENTS IN THE FINITE ELEMENT ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS. Argyris, J. H.; Faust, G.; Szimmat, J.; Warnke, E. P.; Willam, K. J. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Statik und Dynamik der Luft-und Raumfahrtkonstruktionen). 1973. 46p. INIS.

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16617 (LA-5989-MS) GRAVITY-ASSIST HEAT PIPES FOR THERMAL CONTROL SYSTEMS. Deverall, J. E.; Keddy, E. S.; Kemme, J. E.; Phillips, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 15p. Dep. NTIS $4.00.

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16618 (ORNL-SUB-3131-11) EXPLORATORY STUDY OF THE FEASIBILITY OF DEVELOPING STRESS INDICES FOR THERMAL GRADIENTS IN PRESSURE VESSEL NOZZLES. Phase Report 117-11. Rodabaugh, E. C. (Battelle Columbus Labs., Ohio (USA)). 12 May 1975. 76p. Dep. NTIS $7.00.

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The report includes calculated stresses, in the form of stress indices, for 8 "models" of nozzles in spherical shells, with three types of temperature gradients, (1) step axial gradient, (2) linear thru-wall gradient, and (3) linear axial gradient. Calculations were made with a shell-type analysis and, for one of the models, a calculation was also made using a finite-element analysis. In addition, the results are presented of an exploratory investigation into the feasibility of obtaining stresses at nozzles in pressure vessels directly and simply from the specified fluid temperature transient, thereby eliminating the costly and time-consuming heat transfer analysis as well as the detailed thermal stress analysis. (4 references) (auth)

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Design of high reliability nuclear components for use at elevated temperature is considered. The design is related to the design of structures at lower temperature and structures with lesser reliability requirements. The application of design by analysis is considered in some detail. It is concluded that procedures in addition to design by analysis are required for reliable results at elevated temperature. Some approaches are suggested. (Metals Abstr.)

16620 BUTTERFLY VALVES: GREATER USE IN POWER PLANTS. McCoy, M. Power Eng.; 79: No. 7, 56-59(Jul 1975).

Improvements in butterfly valves, particularly in the areas of automatic control and leak tightness are described. The use of butterfly valves in nuclear power plants is discussed. These uses include service in component cooling, containment cooling, and containment isolation. The outlook for further improvements and greater uses is examined. (JWR)

16621 PROCESS FOR WITHDRAWING RADIOACTIVE GASES FROM A NUCLEAR REACTOR. Frumerman, R.; Brown, W. W. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,209,177/A/. 16 Oct 1973. 7p. (In French).

The coolant is evacuated to a reduced level in order to provide a supplementary gas space which is then filled with an inert gas. The coolant is circulated continuously in order to facilitate the release of the radioactive gas from the coolant to the inert gas, which is then evacuated with the radioactive gases and stored in aging tanks. This procedure permits a rapid reduction of radioactive gases in coolants. (tr-FR)

16622 NEW TECHNIQUES FOR INSPECTION AND MAINTENANCE OF REACTORS. Vertut, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service

Technique d'Etudes de Protection et de Pollution Atmospherique). pp 74-75 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The various techniques for working in a hostile environment have been improved. Recent frogmen suits make work under containment possible. The double-door system is used for many applications. It is used to evacuate wastes from hot cells under clean conditions. It is possible to simplify loading transport containers and reduce liquid waste cleaning. Bilateral-force reflecting manipulators were developed. They are used for reactor inspection and maintenance. (FR)

16623 METHOD FOR DETECTING A FLUID LEAKAGE IN A NUCLEAR REACTOR. Hicks, J. M. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,207,274/A/. 13 Nov 1973. 9p. (In French).

16624 GRIP FOR FUEL AND CONTROL ELEMENTS OF A NUCLEAR REACTOR. Jones, T. A.; Anthony, A. J. (to Combustion Engineering, Inc., New York (USA)). French Patent 2,211,719/A/. 30 Nov 1973. 23p. (In French).

16625 A HEAT-EXCHANGER APPARATUS, SPECIALLY SUITABLE AS STEAM GENERATOR. Trepaud, Georges. French Patent 2,208,104/E/. 30 Nov 1972. 22p. (In French).

The invention relates to a heat exchanger according to the main patent comprising an annular exchange space defined by an outer cylindrical enclosure and a central funnel, wherever is located an annular bundle constituted by a concentric sheet of straight or waved tubes which are secured by their end portions. (FR)

16626 JOINING TECHNIQUES FOR REMOTE MAINTENANCE OF NUCLEAR STEAM GENERATORS. Coughlin, S. A.; Stark, L. E.; Brown, E. L.; Johnson, W. R. (Babcock and Wilcox Co., Alliance, OH). Proc. Am. Power Conf.; 36: 266-233(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Procedures for explosive plug welding and internal sleeve welding to repair steam generator tubes are described. (DCC)

16627 SEISMIC PERFORMANCE OF RELAYS: PRESENT STATUS AND FUTURE TRENDS. Scharf, L.; Stafliano, E. L. Jr. (General Electric Co., Philadelphia). Proc. Am. Power Conf.; 36: 1080-1084(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

A program is described for testing the seismic performance of nuclear power plant relays and control switches that are essential to the safe shutdown and isolation of the reactor during a seismic event. The test results were analyzed. It was concluded from this analysis that relay performance is a function of both relay equipment design and environmental conditions, that new relay performance criteria to define fragility level and documentation requirements should be established, and that more test data is needed to determine the seismic capability of the total protective installation. (LCL)

16628 INTEGRITY OF REACTOR PRESSURE VESSELS FOR LIGHT WATER COOLED NUCLEAR REACTORS. Vons, L. H. (Stichting Reactor Centrum Nederland, The Hague). Atoomenerg. Haar Toepass.; 17: No. 5, 102-111(May 1975). (In Dutch).

A failure criterion of one-per-million-per-year-per-vessel has been recommended for nuclear plant, this being considerably less than for non-nuclear equivalents. Materials aspects are considered, and non-destructive techniques required for the vessel to ASME, Section III, and for the steam generator to ASME, Section I codes are listed. Experimental graphs are shown for proof test results in terms of surface energy factors versus temperature in connection with notch ductility criteria. Statistical surveys are given of large numbers of vessels in the USA, W. Germany and in the UK, with a breakdown in terms of gravity of failure and likely cause. (GC)

Reactor Fuels

Refer also to abstracts 13750, 13837, 13884, 13892, 13907, 13909, 13910, 13920, 13921, 13923, 13924, 13927–13929, 14271, 14754, 14778, 14932, 16313, 16657, and 16666.

16629 (GKSS-75/E/2) CHECK OF THE ACCURACY OF THE HEAT-RESISTANCE APPROXIMATION IN UO_2 FUEL ROD DYNAMIC BEHAVIOUR. Fiebig, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Inst. fuer Physik). 6p. (In German). INIS.

18 figs.; 7 refs. Published as special print in Atomkernenergie v. 24(2), 1974, p. 105-110.

The heat resistance approximation used for description of a fuel rod in a water reactor core is checked by calculations with the program TOODEE. It is shown that use of a quasistationary approximation is sufficient for time dependent realistic reactor excursions. Non-linearities in heat capacity and heat conductivity of UO_2 cannot be neglected if accuracy less than 10% is attempted. (auth)

16630 INTRODUCTION TO THE STUDY OF VIBRATIONS IN PROTOTYPES OF NUCLEAR FUEL ELEMENTS. Criado Sancho, M.; Luis Luis, P.; Romero, E.; Diaz Diaz, J. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 19: No. 93, 23-29 (1975). (In Spanish).

The importance and necessity of the study of the vibrational behavior of fuel elements is shown. Specific techniques and methods for studying fuel element vibrations and the most significant instrumental units are described. Experimental results obtained and the major areas of work in this area of the Division of Metallurgy of J. E. N. are given. (tr-auth)

16631 CALCULATION OF THE TEMPERATURE FIELDS OF BUNDLES OF FUEL ELEMENTS IN AXIAL TURBULENT FLOWS OF HEAT-TRANSFER MEDIA WITH VANISHINGLY SMALL PRANDTL NUMBERS. Ushakov, P.A. (Physics and Power Institute). High Temp. 12: No. 4, 677-685 (Mar 1975).

The article gives a more general solution than that of Nijsing and Eifler to the problem of heat transfer in regular arrays of rod-type fuel elements, with the longitudinal flow of heat-transfer media around the elements with Pr—0. To this end, there is introduced a generalized parameter of the thermal similarity of the fuel elements, proposed earlier by the present author. The solution is valid for any arbitrary fuel elements with axisymmetric properties. The article also proposes a simple approximate solution, based on the use of a model of "piston" flow, and which is in satisfactory agreement with the "exact" solution. The results of the calculations are illustrated by curves. (auth)

16632 UO_2 DENSIFICATION. Irradiation Results, Laws and Methods. Contenson, G. de; Lestiboudois, G.; Vignesoult, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Technologie). pp 87-89 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Specific studies of the densification phenomenon were undertaken, as a result of which: the radial and longitudinal densification kinetics of different types of fuels were elucidated; an out-of-pile test representative of in-pile densification was perfected; and a densification model was suggested to predict the behavior of fuel element. (FR)

16633 COMETHE III-G FOR FUEL ROD BEHAVIOR PREDICTION. Hoppe, N. (Societe Belge pour l'Industrie Nucleaire, Brussels). pp 89-90 of La maturite de l'energie nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French).

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The Belgonucleaire Comethe code is a typical example of an (R-Z) mathematical approach to account for the observed phenomena. This code applies to any cylindrical fuel rod with oxide fuel in metallic claddings. It is thus of interest for almost all types of nuclear reactors. (FR)

16634 CERAMIC NUCLEAR FUEL PELLETS. (to British Nuclear Fuels Ltd., Capenhurst). French Patent 2,214,156/A/. 11 Jan 1974. 12p. (In French).

16635 NUCLEAR FUEL METAL CANS. (to UKAEA). French Patent 2,209,170/A/. 14 Sep 1973. 10p. (In French).

16636 FUEL PERFORMANCE: IMPACT OF DENSIFICATION. Chernock, W. P.; Duncan, R. N.; Harkness, S. D. (Combustion Engineering, Inc., Windsor, CT). Proc. Am. Power Conf.; 36: 234-240(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

Results of in-reactor tests designed to study the extent and kinetics of densification for fuels with various microstructures and initial densities are presented. A review of mechanisms associated with in-reactor densification is included to provide a link between theory and the experimental observations showing the dependence of densification on UO_2 microstructures. (11 references) (DCC)

Reactor Control Systems

Refer also to abstracts 14400 and 16666.

16637 (CEA-CONF-2932) TECHNICAL ASSISTANCE FOR THE INSTALLATION AND START-UP OF EQUIPMENT. Garau, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Services d'Electronique). 14 Nov 1974. 5p. (In French). (CEA-SES-PUB-SAI-74-240). INIS.

From One-day meeting on the electronic instrumentation for nuclear reactor control; Paris, France (18 Dec 1974).

A well-established technical aid procedure for the installation and start-up of reactor safety and control equipment is proposed. A nuclear instrument trial program can be used to judge whether the material offers the required reactor safety and availability standards. A typical document allowing the establishment of a trial program defining in detail the appropriate test procedures is proposed. (FR)

16638 (HEDL-TME-75-19) COMPILATION OF BORON CARBIDE DESIGN SUPPORT DATA FOR LMFBR CONTROL ELEMENTS. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 55p. AT.

Data and design correlations are presented for boron carbide structural, mechanical, and physical properties, compatibility with stainless steel and sodium, and irradiation behavior pertaining to helium release, swelling, and tritium production and retention. 45 references. (auth)

16639 (HEDL-TME-75-35) GAMMA HEATING RATES IN FTR EUROPIA CONTROL ASSEMBLIES. Ward, J. T. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. 70p. AT.

Gamma heating rates were calculated for several materials in proposed Fast Test Reactor (FTR) europia absorber assemblies. The three-dimensional FTR analysis found gamma heating to peak at 12.8 watts/gm of europia near the tip of a half-inserted row 5 control rod. Experimental verification of theoretical and computational methods was obtained by comparison with measurements from the Engineering Mockup Critical Assembly (EMC) at the ANL/ZPR-9 facility. Spatially localized heating gradients in the vicinity of a single absorber assembly were found to be unimportant in affecting peak heating rates. These results are necessary for conducting thermal hydraulic analyses of Liquid Metal Fast Breeder Reactor systems under europia control. 13 references. (auth)

16640 (RN-S-0057) DYNAMIC REQUIREMENTS FOR BLOCK I ENGINE CONTROL SYSTEM. (Aerojet-General Corp., Azusa, Calif. (USA)). Feb 1964. 43p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

The basic control requirements and nominal performance characteristics of Block I NERVA engines are established. Data contained herein were derived through an analysis conducted on the power range analog model of the Block I engine. The model included a storage tank, turbopump assembly, nozzle, reflector, shield, reactor, and thrust chamber. (auth)

16641 (RN-S-0066) CONTROLS ANALYSIS PRESENTATION TO SNPO-C. (Aerojet-General Corp., Azusa, Calif. (USA)). 5 Mar 1964. 60p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

16642 (TID/SNA-2269) DYNAMIC REQUIREMENTS FOR BLOCK I ENGINE CONTROL SYSTEM. Kornfeld, E. L.; Mageean, J. V. (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Sep 1963. 18p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The engine control system consists of three main control loops: the flux level control loop, the core exit gas temperature control loop and the chamber pressure control loop. These control loops, when combined with the engine programmer and the cooldown control system, provide the complete engine control system. A block diagram is provided showing the basic control system components and their relationship at design point operation. The reactor control subsystem consists of the flux level control loop, the temperature control amplifier and various logic circuits to accomplish nuclear startup and provide integration with the engine programmer. The drum control actuators and the turbine power control actuator are complete control loops within themselves and are subloops of the flux control loop and the chamber pressure control loop, respectively. The control system design is tailored to enable the engine and vehicle systems to meet the performance requirements by providing the demanded inputs to the engine at the desired time so that the overall engine mission may be achieved in a manner that provides a smooth transition from one operating point to another in the desired time period. All of the engine performance requirements are governed by the mission requirements, safety limits, and the engine component limitations such as maximum and minimum temperatures and pressures, maximum rates of change of temperatures and pressure and other specific component limitations. Safety limits specify the reactor control drum rates and reactor periods and are governed by the ability of the control system to detect and control these parameters. (auth)

16643 (WANL-TME-357) PRELIMINARY STUDY OF THE EFFECTS OF THE VELOCITY LIMITS OF CONTROL DRUM ACTUATORS UPON REACTOR CONTROL SYSTEM STABILITY IN THE POWER RANGE. Steiner, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 May 1963. 26p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

The effects on NERVA reactor control system characteristics of reduced velocity limits in the control drum actuators have been studied. It is found that drastic reductions in the velocity limit adversely affect the stability of the temperature control loop and reduce the response of the neutron density control loop. Results are optimistic with regard to moderately reducing the actuator velocity limit. Future studies are required to specify, with certainty, velocity limits adequate under all conditions of operation, and to investigate modifications in the neutron density and temperature control loops that would facilitate reduced velocity limits. (auth)

16644 (WANL-TME-525) NRX-A2 CONTROL SYSTEM PERFORMANCE DURING REACTOR STARTUP. Hafer, J. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Sep 1963. 29p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

The existing reactor power and temperature control systems in Test Cell A (KIWI-B4A controllers) have been analyzed to determine their suitability for control of the NRX-A2 series of reactor tests. The KIWI-B4A controllers have successfully controlled a reactor similar to the NRX-A2 design and the control hardware is presently integrated into the Test Cell A complex. The KIWI-B4A controller compensations and gains, as reported herein, exhibit adequate stability as demonstrated by frequency response and programmed startup in the subpower and power range. It is recommended that the KIWI-B4A power and temperature control systems as described be used during the NRX-A2 series of tests. (auth)

16645 (WANL-TME-1967) REACTOR CONTROLS CONCEPT TRADE STUDY. Trade Study No. 701. Data Item S-54. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 121p. Dep. NTIS $9.25.

Declassified 10 Sep 1973.

The objective was to compare twenty NSS reactivity control concepts for NERVA on the basis of performance, reliability, weight, safety, development risk, and schedular impact. The candidate concepts included combinations of type of control drum actuation (binary and continuous or analog), individually driven drums, and ganged drum systems, number of drums (12, 18, and 36), and type of Structural Support Coolant Supply System (SSCSS) flow control (non-variable, binary and continuously variable). In addition, drum span requirements were identified for various operational modes and types of SSCSS flow control. A 36 control drum configuration, each with its own analog type actuator, was selected together with a continuously variable flow control on the SSCSS. This concept was selected because it provides the maximum reactivity control flexibility and maximizes core reliability by minimizing temperature variations in the core both during normal operation and also in the event of inoperative control drums. The work is limited in application to the 50 minute duration, hot bleed cycle reactor. (auth)

16646 TIME OPTIMAL CONTROL OF THE NUCLEAR REACTOR USING THE MAXIMUM PRINCIPLE. Kwack, E. H. J. Korean Inst. Electron. Eng.; 11: No. 3, 131-135(1974).

The maximum principle of Pontryagin provides the method to obtain the optimum control switching time and switching points on the nuclear reactor. The control trajectories transferred from the initial state to the target state are optimized based on the time optimal control method with given reactor parameters and piecewise constant input values. (Korean Sci. Abstr.)

16647 AUTOMATING NUCLEAR POWER STATIONS. Goetz, A. (Kernkraftwerk Stade G.m.b.H. (KKS) (F. R. Germany)); Jaerschky, R. (Isar-Amperwerke A. G., Muenchen (F. R. Germany). Hauptabteilung Kraftwerke); Reiss, E. (Preussische Elektrizitaets-A. G. (Preussenelektra), Wuergassen (F. R. Germany). Kernkraftwerk). Atomwirtsch., Atomtech.; 20: No. 2, 78-82(Feb 1975). (In German).

The degree to which nuclear power stations can be automated is discussed. Automation of the main circuit serves the purpose of improving the availability of the plant. The possible advantages in terms of availability are compared with potential disadvantages. The operating behavior of American nuclear power stations is examined and compared with the automation status and the operating experience of nuclear power stations in the Federal

Republic of Germany, especially the Stade and Wuergassen nuclear power stations. (auth)

16648 ELECTRONIC COMPARATOR CIRCUIT AND MORE PARTICULARLY CONTINUANCE LEVEL DETECTOR. Neuner, J. A.; Traversi, M. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,212,548/A/. 20 Dec 1973. 16p. (In French).

This detector is characterized by the fact that it consists of a comparator to compare the level of n input signals, where n is any whole number. The comparator responds to the signal among the n input signals which has an extreme analog value with a predetermined algebraic sign, at a given moment, with respect to n – 1 other input signals so as to furnish an output analog signal smoothed electrically and practically identical to the input signal detected. The invention finds its application in the area of numerical position commands of control rods in reactors. (tr-FR)

16649 POSITION INDICATING INSTALLATION. Neuner, J. A.; Traversi, M.; Thompson, F. T.; Vercellotti, L. C. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,212,532/A/. 2 Jan 1974. 81p. (In French).

The invention concerns a position indicator installation for the display of the position of a mobile elongated element having one degree of freedom along its longitudinal axis. The installation is characterized by the fact that it consists of an assembly of imbricated detector elements, grouped by twos, placed in the vicinity of the longitudinal axis in two distinct groups in order to create electrical output signals. The installation also has means of comparing and using selectively the electrical signals and of indicating the position of the mobile element with respect to the detection elements. The installation can be used in the nuclear area, for example, to control the position of control rods in reactors and to control the power equilibrium of the reactor. (tr-FR)

16650 AUTOMATIC PROGRAMMING SYSTEM FOR THE STANDARDIZATION OF MULTIPLEX TRANSMISSION SYSTEMS. Neuner, J. A.; Traversi, M. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,212,586/A/. 3 Jan 1974. 10p. (In French).

The invention concerns a standardized multiplex signal transmission. The system has a plurality of inputs which are addressed by a central control unit. This unit provides an address to an output unit associated with the addressed input concerned which gives a ready signal to the control unit. The control unit then treats the addressed input according to a desired output form and transmits this to a corresponding output unit. The system is applicable to the control of the position of reactor control rods. (tr-FR)

16651 NUCLEAR POWER PLANT COMPUTER SYSTEM WITH REMOTE MULTIPLEXING. Union, D. C. (General Atomic Co., San Diego, CA). Proc. Am. Power Conf.; 36: 891-897(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

A modern nuclear power plant computer system is described with particular emphasis on the operator console. The system can be used in all nuclear power plants and could be adopted for use in fossil-fuel power plants. 5 references. (auth)

16652 STAINLESS CASTINGS PROVIDE NUCLEAR POWER. Foundry Manage. Technol.; 102: No. 10, 92; 94(Oct 1974).

The use of stainless steel castings in the boiling water reactor nuclear power plants is trouble-free due to their corrosion resistance and strength. The alloys CA-15 (12Cr–1Ni) and CA-6MN (13Cr–4Ni) are hardenable high-strength corrosion resistant. Types CF-8 (19Cr–9Ni) and CF-8M (19Cr–9Ni–2.5Mo) offer superior corrosion resistance and are used for feed-water pumps and valves. Other parts of the power plants made of the above alloys are described. (Metals Abstr.)

Nuclear Power Plant Economics

Refer also to abstract 16296.

16653 THE NUCLEAR STEP. Giraud, A. (CEA, 75 – Paris (France)). Rev. Ing. Ec. Natl. Super. Mines.; 27: No. 234, 16-19 (Jul 1974). (In French).

The industrial policy of France in the nuclear field is presented: enriched uranium and ordinary water reactors, breeder reactors, high temperature reactors. The fuel cycle is analyzed as are the possibilities of using nuclear energy. Some reflections are presented on the role of nuclear energy in the construction of Europe. (FR)

16654 THE FUTURE DEVELOPMENT OF NUCLEAR POWER FROM THE POINT OF VIEW OF THE OECD. Kerstan, F. Glueckauf.; 111: No. 2, 90-91(Jan 1975). (In German).

After a short introduction to the tasks of the OECD agency a comprising presentation of its second annual report is given. Questions for the future development of nuclear energy in the western world are prominent – especially the safety of uranium support. Estimates are given for the installed nuclear power in the countries of the OECD up to 1990, the corresponding need of uranium and separation capacity, and the expected need of investment. (GE)

16655 THE NUCLEAR POWER ECONOMY OF ITALY. Arch. Energiewirtsch.; 29: No. 2, 109-118(Feb 1975). (In German).

See also Nucl. Eng. Int. 1973 v. 18(209) p. 777-800.

A review is given on the present state of the Italian nuclear power development. The PEC reactor which has been developed within the frame of the fast breeder reactor program is described using the most important data. A description is given of the structure and tasks of the Italian nuclear industry. (GE)

16656 IMPROVEMENTS ON THE AVAILABILITY OF NUCLEAR POWER PLANTS THROUGH RELIABILITY ANALYSES. Gruetter, F.; Bogh, P. (Motor–Columbus Ingenieurunternehmung A. G., Baden (Switzerland)). pp 148-156 of Reports: Power Plants 1974. Essen, F. R. Germany; VGB-Dampftechnik (1974). (In German).

From Congress power plants 1974. Annual meeting of the VGB; Dortmund, F. R. Germany (9 Jul 1974). With abstract.

Some basic problems are discussed, and some results of analyses of main cooling systems with wet and dry cooling towers in projected power reactors are presented. (GE)

16657 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE. Volume 36. Conference Held at Chicago, Illinois, April 29–May 1, 1974. Chicago; Illinois Institute of Technology (1974). 1180p. (CONF-7404100-). $25.00.

Separate abstracts are presented for 27 papers concerning standardized designs of nuclear power plants; power plant startup and operating experience; fast breeder reactor development for commercial power plants; quality assurance, reliability, and safety of nuclear plants; current developments in nuclear fuels; turbine-generator control systems for nuclear power plant; water chemistry for nuclear power plants; and nuclear power plant control systems. (DCC)

For abstracts of individual papers see: 14271, 16208–16211, 16232–16238, 16254–16256, 16294–16297, 16591, 16592, 16626, 16627, 16636, 16651, 16659, and 16683.

Reactor Fuel Cycle Economics

16658 (IEA-37) SURVEY OF THORIUM UTILIZATION IN THERMAL POWER REACTORS. Oosterkamp, W. J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

The thorium cycle offers substantial savings in uranium consumption and separative work for reactor with a high conversion ratio. The reactors that can be used are of a standard type and will need only slight modifications. A very interesting type is the Th-metal pressurized water reactor into which existing pressurized water reactors can be converted. Fuel fabrication facilities to be set up in Brasil should be able to handle slightly radioactive fuel and provide for removal of Th-228 from uranium. Reprocessing plants should be optimized for a large through put of thorium even if initially the uranium cycle will be used. A limit on the enrichment of feed uranium will at least double the uranium consumption. (45 references) (auth)

16659 THORIUM UTILIZATION IN AN FBR/HTGR POWER SYSTEM. Brogli, R. H.; Schultz, K. R. (General Atomic Co., San Diego, CA). Proc. Am. Power Conf.; 36: 247-258(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

A comparison of various fuel cycles is presented. Energy production costs of various systems are compared. Of the several possible systems, the combination of a GCFR type reactor producing ^{233}U in a thorium blanket with several ^{233}U burning HTGR type reactors to form a symbiotic GCFR/HTGR system appears to be the optimal self-contained power system. (6 references) (auth)

Reactor Licensing and Regulation

Refer also to abstract 16592.

16660 (NP-20456, pp vp Paper 8) AMENDMENTS TO 10 CFR PART 50 ON "AS LOW AS PRACTICABLE" AS PRESENTED IN THE CONCLUDING STATEMENT OF POSITION OF THE REGULATORY STAFF. DOCKET RM-50-2. 1974.

In environmental analysis and environmental monitoring for nuclear power generation. (California Univ., Berkeley (USA)).

The following appendix is presented: numerical guides for design objectives and limiting conditions for operation to meet the criterion, as low as practicable, for radioactive material in light-water cooled nuclear power reactor effluents. A discussion is given of calculated annual air doses due to gamma and beta radiation and radioactive iodine and radioactive material in particulate form above background released to the atmosphere. (HLW)

16661 (NP-20481) DUKE POWER COMPANY TOPICAL REPORT: QUALITY ASSURANCE PROGRAM. DUKE-1, AMENDMENT 2. (Duke Power Co., Charlotte, N. C. (USA)). 14 Feb 1975. 117p. Duke Power Co., Charlotte, NC.

The Duke Power Company quality assurance program is described for all phases of its nuclear power plants. The report is organized like and is generically used for Chapter 17--Quality Assurance of Duke's Safety Analysis Reports. The Duke quality assurance program conforms to applicable regulatory requirements such as 10 CFR 50, Appendix B and to approved industry standards such as ANSI N45.2-1971 and ANSI N18.7-1972 and corresponding daughter standards, or to equivalent alternatives. The program also follows additional guidance developed by the Atomic Energy Commission. (auth)

16662 (NUREG/PRDI-75/7) POWER REACTOR DOCKET INFORMATION. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jul 1975. 55p. TIC $1.85.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the U. S. Nuclear Regulatory Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

16663 (RDT-F-7-3T(6-75)) MARKING OF COMPONENTS AND PARTS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Jun 1975. 10p. RSO.

The surface marking of components and parts purchased in accordance with RDT standards is described. The standard covers permanent identification marking and temporary marking for interim identification, layout, instructional, or control purposes during manufacture or installation that are placed directly on the surface of the item. This standard does not cover the marking of mill material purchased to RDT standards. (auth)

16664 (REG/G-1.20(Rev.1)(6-75)) COMPREHENSIVE VIBRATION ASSESSMENT PROGRAM FOR REACTOR INTERNALS DURING PREOPERATIONAL AND INITIAL STARTUP TESTING. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 8p. NRC.

A method acceptable to the NRC staff for implementing the safety margin requirements with respect to the internals of light-water-cooled reactors during preoperational and initial startup testing is described. Inservice inspections and inservice monitoring programs to verify that the reactor internal components have not been subjected to structural degradation as a result of vibration during normal reactor operation are not covered by this guide. (auth)

16665 (REG/G-1.26(Rev.2)) QUALITY GROUP CLASSIFICATIONS AND STANDARDS FOR WATER-, STEAM-, AND RADIOACTIVE-WASTE-CONTAINING COMPONENTS OF NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 3p. NRC.

This guide describes a quality classification system related to specified national standards that may be used to determine quality standards acceptable to the NRC staff for satisfying General Design Criterion 1 for other safety-related components containing radioactive material, water, or steam in water-cooled nuclear power plants. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position. (auth)

16666 (REG/G-1.70.34(5-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: FUEL SYSTEM DESIGN. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). May 1975. 7p. NRC.

Guides in the 1.70.XX series are issued to identify information that has often been missing from applicants' safety analysis reports at the construction permit and operating license stages of review or to present revisions necessary to make a portion of the Standard Format consistent with the appropriate Standard Review Plans. Information on the fuel system design is presented. (auth)

16667 (REG/G-1.70.36(6-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: ELECTRIC POWER. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 9p. NRC.

Guides in the 1.70.XX series are issued to identify information that has often been missing from applicants' safety analysis reports at the construction permit and operating license stages of review or to present revisions necessary to make a portion of the Standard Format consistent with the appropriate Standard Review Plans. Information on electric power systems is presented. (auth)

16668 (REG/G-1.70.37(6-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: PRESSURIZER RELIEF DISCHARGE SYSTEM. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 3p. NRC.

Guides in the 1.70.XX series are issued to identify information that has often been missing from applicants' safety analysis reports at the construction permit and operating license stages of review or to present revisions necessary to make a portion of the Standard Format consistent with the appropriate Standard Review Plans. Information on the pressurizer relief discharge systems is presented. (auth)

16669 (REG/G-1.70.38(6-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: TRAINING. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 6p. NRC.

Guides in the 1.70.XX series are issued to identify information that has often been missing from applicants' safety analysis reports at the construction permit and operating license stages of review or to present revisions necessary to make a portion of the Standard Format consistent with the appropriate Standard Review Plans. Information on personnel training is presented. (auth)

16670 (REG/G-1.84(Rev.2)(6-75)) CODE CASE ACCEPTABILITY: ASME SECTION III DESIGN AND FABRICATION. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 6p. NRC.

This regulatory guide lists those Section III ASME Code Cases oriented to design and fabrication that are generally acceptable to the NRC staff for implementation in the licensing of light-water-cooled nuclear power plants. (auth)

16671 (REG/G-1.85(Rev.2)(6-75)) CODE CASE ACCEPTABILITY: ASME SECTION III MATERIALS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 6p. NRC.

This regulatory guide lists those Section III ASME Code Cases oriented to materials and testing that are generally acceptable to the NRC staff for implementation in the licensing of light-water-cooled nuclear power plants. (auth)

16672 (REG/G-1.87(Rev.1)(6-75)) GUIDANCE FOR CONSTRUCTION OF CLASS 1 COMPONENTS IN ELEVATED-TEMPERATURE REACTORS (SUPPLEMENT TO ASME SECTION III CODE CASES 1592, 1593, 1594, 1595, AND 1596). (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 4p. NRC.

This guide describes interim licensing guidelines to aid applicants in implementing design requirements with respect to ASME Class 1 components operating at elevated temperatures. This guide applies to high-temperature gas-cooled reactors (HTGRs), liquid-metal fast-breeder reactors (LMFBRs), and gas-cooled fast-breeder reactors (GCFBRs). (auth)

16673 (REG/G-1.94(4-75)) QUALITY ASSURANCE REQUIREMENTS FOR INSTALLATION, INSPECTION, AND TESTING OF STRUCTURAL CONCRETE AND STRUCTURAL STEEL DURING THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Apr 1975. 2p. NRC.

This guide describes a method acceptable to the NRC staff for complying with the Commission's regulations with regard to quality assurance requirements for installation, inspection, and testing of structural concrete and structural steel during the construction phase of nuclear power plants. This guide applies to all types of nuclear power plants. (auth)

16674 (REG/G-4.10(6-75)) IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF MATERIALS RESOURCES. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jun 1975. 2p. NRC.

In accordance with 10 CFR Part 51, applicants are required to discuss any irreversible and irretrievable commitments of resources that would be involved in a proposed action should it be implemented. The construction and operation of nuclear power stations involves commitments of such resources as water, fuel, and materials. This guide identifies a report on material resources that forms a basis acceptable to the NRC staff for required discussions of irreversible and irretrievable commitments of material resources involved in the construction of a 1000 MW(e) pressurized water reactor. (auth)

16675 (UEC-TR-001-1) QUALITY ASSURANCE PROGRAM. (United Engineers and Constructors, Inc., Philadelphia, Pa. (USA)). 1975. 89p.

United Engineers and Constructors Inc. (UE and C) have established and implemented a Quality Assurance Program to provide assurance that the design, procurement and construction (including installation and pre-operational testing--but not operation) of nuclear power plants, performed by UE and C, are in conformance with applicable regulatory requirements and with the design bases specified in the license application. The Quality Assurance Program described is in compliance with the requirements of Appendix B to 10 CFR Part 50. This report addresses and is responsive to the United States Nuclear Regulatory Commission Regulatory Guide 1.70.6, dated July 1974, which describes additional information required in the Quality Assurance Section of the Preliminary Safety Analysis Report for Nuclear Power Plants. (auth)

16676 NUCLEAR REGULATORY COMMISSION AUTHORIZING LEGISLATION, FISCAL YEAR 1976. Hearing Before the Subcommittee on Legislation of the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Fourth Congress, First Session on Proposed Budget of the Nuclear Regulatory Commission for Fiscal Year 1976, March 19, 1975. Washington, DC; Joint Committee on Atomic Energy (1975). 423p. GPO.

16677 NUCLEAR POWERPLANT SITING AND LICENSING. Volume II: Appendixes. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session on H.R. 11957, H.R. 12823, H.R. 13484; and S. 3179. Bills related to the need for review of and improvements to the process for bringing nuclear powerplants on line, March 19, 20, 21, 22; April 24, 25, 26; and May 1, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 555p. GPO.

16678 NUCLEAR POWERPLANT SITING AND LICENSING. Volume I: Hearings. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session on H.R. 11957, H. R. 12823, H.R. 13484; and S. 3179. Bills related to the need for review of and improvements to the process for bringing nuclear powerplants on line, March 19, 20, 21, 22; April 24, 25, 26; and May 1, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 975p. GPO.

16679 REACTOR OPERATOR TRAINING PROGRAMS UTILIZING NUCLEAR POWER-PLANT SIMULATORS. Collins, P. F. Nucl. Saf.; 16: No. 4, 482-488(1975).

The Nuclear Regulatory Commission (NRC) requires that all operators of the controls of nuclear facilities be licensed. Applicants for licenses must pass written examinations and operating tests administered by NRC. Operating experience may be obtained through approved training programs that utilize nuclear power-plant simulators. Since 1969, NRC's predecessor, the USAEC, has accepted four such training programs that are administered by the vendors of nuclear power-plant systems. The programs consist of (1) nuclear fundamentals courses, (2) research-reactor operation, (3) lectures on nuclear power-plant design, (4) observation at operating nuclear power plants, and (5) simulator operations. In 1971, the USAEC approved the use of simulators in training programs and during the examinations. These programs are limited to personnel from facilities having control rooms which are closely parallel to that of the simulator. The NRC also requires licensed individuals to participate in requalification programs that require licensees to manipulate reactor controls through a specified number of evolutions during their license tenures. If the simulator's operating characteristics and control room are similar to those of the facility involved, manipulation of simulator controls is permitted so that the number of plant evolutions solely for requalification can be minimized. The NRC examiners have found that individuals trained using simulators have a better understanding of plant responses to transient conditions and abnormal situations and also are more confident in answering questions that require prediction of plant responses to postulated situations. Also, simulators are extremely effective for examining and evaluating individuals. (auth)

16680 ANSI-NSMB NUCLEAR STANDARDS PROGRAM. Savolainen, A. W. Nucl. Saf.; 16: No. 4, 415-421(1975).

The American National Standards Institute (ANSI)–Nuclear Standards Measurement Board (NSMB) nuclear standards program has, since its infancy, proceeded on a base of long-term plans and broad goals beyond those of the individual standards projects undertaken. The effort in the development of nuclear standards has focused on many objectives, including: the expeditious development of high quality standards in areas of need; maximum coordination of the program to promote a disciplined engineering approach to design construction of nuclear facilities, to ensure adequate and safe plants, and to provide utility and safety in the use of radioactive materials; participation in the program by those who will ultimately use the standards; relief of volunteer professionals from administrative burdens that do not utilize their time effectively; and increased participation by professional standards-writing organizations. The informational tools are now in place to assist standards-writing groups in organizing and completing their tasks, to provide standards-management groups with a basis for evaluating progress, and to aid program planners in assuring achievement of their goals with a minimum of overlap and duplication. As of January 1975, approximately 1500 standards had been identified as having nuclear application, and there were 551 active projects under the cognizance of NSMB. (auth)

16681 NEW FEDERAL WATER POLLUTION CONTROL ACT AND ITS IMPACT ON NUCLEAR POWER PLANTS. II. The Effect of FWPCA on NRC Licensing Jurisdiction and Procedures. Davis, J. P. Nucl. Saf.; 16: No. 4, 421-433(1975).

The interelationship of the U. S. Environmental Protection Agency (EPA) and the U. S. Nuclear Regulatory Commission (NRC) environmental reviews under the Federal Water Pollution Control Act (FWPCA) and other statutes are examined. The scope of EPA's authority to regulate radioactive materials discharge under FWPCA and the impact on NRC regulation under the Atomic Energy Act are discussed, and the effect of FWPCA on NRC environmental jurisdiction under NEPA is considered. In addition, the problems involved in possible overlapping agency jurisdictions and the EPA–AEC Memoranda of Understanding are analyzed. Finally, the prospects for a workable discharge permit system under the FWPCA are discussed. (auth)

16682 QA PROGRAM TO DEAL WITH NONCONFORMANCES. Lutz, D. E. (Argonne National Lab., IL). Power Eng.; 79: No. 7, 53-55(Jul 1975).

The value of a formal quality assurance program for dealing with raw materials, components, and construction practices which do not meet specified requirements for nuclear plant construction is discussed. (JWR)

16683 CHANGING ROLE OF QUALITY ASSURANCE IN NUCLEAR POWER. Kreh, E. J.; Henning, F. W.; Giglio, J. M. (Westinghouse Electric Corp., Pittsburgh). Proc. Am. Power Conf.; 36: 210-214(1974).

From American power conference; Chicago (29 Apr 1974). See CONF-7404100-.

16684 1973 ANNUAL REPORT OF THE ITALIAN NUCLEAR STANDARDS COMMITTEE. Ing. Nucl.; 15: 15-19(1974). (In Italian).

Since 1968 the Italian Nuclear Standards Committee (UNICEN) collaborates closely with the ISO/TC.85 Nuclear Energy Committee. During the year, the committee worked actively in the development of nuclear standards through its 7 subcommittees and a large number of working groups. Subcommittees operated in the following areas: 1. Terminology and technical design; 2. radiological protection; 3A. safety of nuclear components; 3B. conventional components; 3C. nuclear systems; 3D. safety of electric and electronic systems and components; and 4. radioisotopes. The issued standards and drafts are listed together with titles of translated IAEA handbooks. (TTT)

GENERAL AND MISCELLANEOUS

Law

16685 (MBL-1974-22) REQUIREMENTS RESULTING FROM NUCLEAR ENERGY LAW WITH RESPECT TO ARMY PERSONNEL. Aten, J. B. T. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 25p. (In Dutch).

A review is given of the levels of expert knowledge required by the law in the Netherlands for personnel manipulating any source of hazardous radiation, with special emphasis on the situation in the armed forces. Five different levels are distinguished and described. Training courses and the institutions providing them are listed. Regulations are given for different types of work such as handling of medical and technical x-ray equipment, any apparatus emitting ionizing radiation both primary and secondary, radioactive materials, and open and closed sources. In an appendix eleven radionuclides as employed by the armed forces are listed and their use indicated. (NL)

16686 PROVIDING AN AUTHORIZATION FOR AN EX GRATIA PAYMENT TO THE PEOPLE OF BIKINI ATOLL, IN THE MARSHALL ISLANDS OF THE TRUST TERRITORY OF THE PACIFIC ISLAND. House of Representatives, Ninety-Fourth Congress, First Session, May 1, 1975. Washington, DC; Committee on Interior and Insular Affairs (1975). 4p. GPO.

House Rule 5158 to authorize payment of $3,000,000 to the people of Bikini Atoll is reported. Background information is included along with discussions of need, cost, inflationary effects, and compliance. (JRD)

Management

16687 (AERE-Bib-190) LIST OF UNCLASSIFIED DOCUMENTS BY THE STAFF OF MATERIALS DEVELOPMENT DIVISION, AERE, HARWELL FROM JANUARY 1972 TO DECEMBER 1974. Sambell, R. A. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1975. 27p. Dep. NTIS (US Sales Only) $4.50. UK £1.00.

This list constitutes 270 items of unclassified material published or presented between January 1972 and December 1974 by the staff of Materials Development Division. It covers reports, memoranda, bibliographies, articles in periodicals, conference papers, books, theses, and patent specifications. It is planned to issue a list annually from now on. (auth)

16688 (INIS-mf-1692) ACTIVITY REPORT, 1973. (Nuclear Energy Agency, 75 - Paris (France)). [nd]. 71p. INIS.

The second activity report comprises four chapters entitled: nuclear power (present and future), regulatory aspects, technical development, and nuclear energy information. A number of changes in the programme and priorities of NEA were brought into effect during 1973. These changes involved a greater policy orientation than previously in the Agency's work, with increasing attention to such matters as radiological protection, safety of nuclear installations, radioactive waste management, and the basic legal and administrative framework necessary for the satisfactory regulation of problems in these fields. In addition, preliminary work began towards improved public understanding of nuclear energy. (auth)

16689 (NP-20409) EIGHTEENTH ANNUAL REPORT, 1973/74. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1974. 76p. Dep. NTIS (US Sales Only) $7.00.

A summary is presented of work at Riso: reactor technology, irradiation, environment, agriculture, basic research, etc. The Inspectorate of Nuclear Installations and international collaboration are also discussed. Research facilities at Riso are described. (DLC)

16690 ATOMIC ENERGY AND THE DEVELOPMENT OF LARGE TEAMS AND ORGANIZATIONS. Massey, H. (University Coll., London). Proc. R. Soc. (London), Ser. A; 342: No. 1631, 491-497(15 Apr 1975).

A survey of the research organizations which have been involved in nuclear research from the 1930s to the present time, is given. Following the small beginnings at the Cavendish Laboratory prewar, the achievements of the large, yet closely knit, community on the Manhattan Project are considered. Post war, the Atomic Energy Research Establishment was set up and developed into the largest research complex of its kind in the UK, including at first both the science of nuclear physics and the technology of nuclear power. The contributions made by universities to research at this period are mentioned but subsequentially, as facilities grew in magnitude and compexity, the National Institute for Research in Nuclear Science and C.E.R.N. were inaugurated as centers for fundamental nuclear research. (UK)

16691 EMERGENCY EXERCISES AT NUCLEAR ESTABLISHMENTS. Sevc, J.; Chysky, J. (Inst. of Hygiene and Epidemiology, Prague). pp 299-304 of Proceedings of the 6th Conference on Radiation Hygiene. II. Trnovec, T. (ed.). Hradec Kralove, Czech.; Purkyne Medical Research and Postgraduate Inst. Press (1973).

From 6th conference on radiation hygiene; Jasna Pod Chopkom, Czechoslovakia (27 Nov 1973). See CONF-731171-P2.

Analyses of the causes and consequences of accidents at nuclear establishments stress the importance of preventive measures for decreasing the frequency of accidents and for reducing their consequences. This report gives some findings based on experiences gained during seven emergency exercises. The preparation and evaluation of the emergency exercises are discussed. (ERB)

16692 RESEARCH IN PUBLIC ORDER. The Main Tasks of the Gesellschaft fuer Kernforschung m.b.H. Karlsruhe. KFK-Nachr.; 6: No. 4, 1-3(1974). (In German).

A description is given of the coming in office of the new board of directors of the GfK and their endeavors, to consider the position and setting of tasks of the Gesellschaft fuer Kernforschung and to newly define the present and future main tasks taking account of the research policy aims of the Federal Government and the Advisory Council for Science and Research. The main tasks are the securing of the fuel supply for the production of nuclear energy, the processing and ultimate storing of radioactive materials and the safety of nuclear plants. (GE)

Miscellaneous

Materials

16693 (EURISOTOP-96) USE OF RADIOACTIVE TRACERS IN THE SEMICONDUCTING INDUSTRY. Akerman, K. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Jan 1975. 104p. (In German). Dep. NTIS (US Sales Only) $8.25.

The importance of the semiconductor industry to the German economy is summarized and the production methods are briefly reviewed. The use of radioactive tracers in the purification of the initial materials (germanium tetrachloride, germanium dioxide, silicon tetrachloride, and chlorosilane) and in the purification of the semiconductor materials (Ge, Si, and Al) is discussed in detail. Radioactive isotopes are also used in the study of the conditions for the production and doping of single crystals. The density of the finished semiconductor element can be tested with isotopes. A brief discussion is given of other nuclear applications in this field and the significance of semiconductor devices for nuclear technology. (JSR)

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